Electrical World

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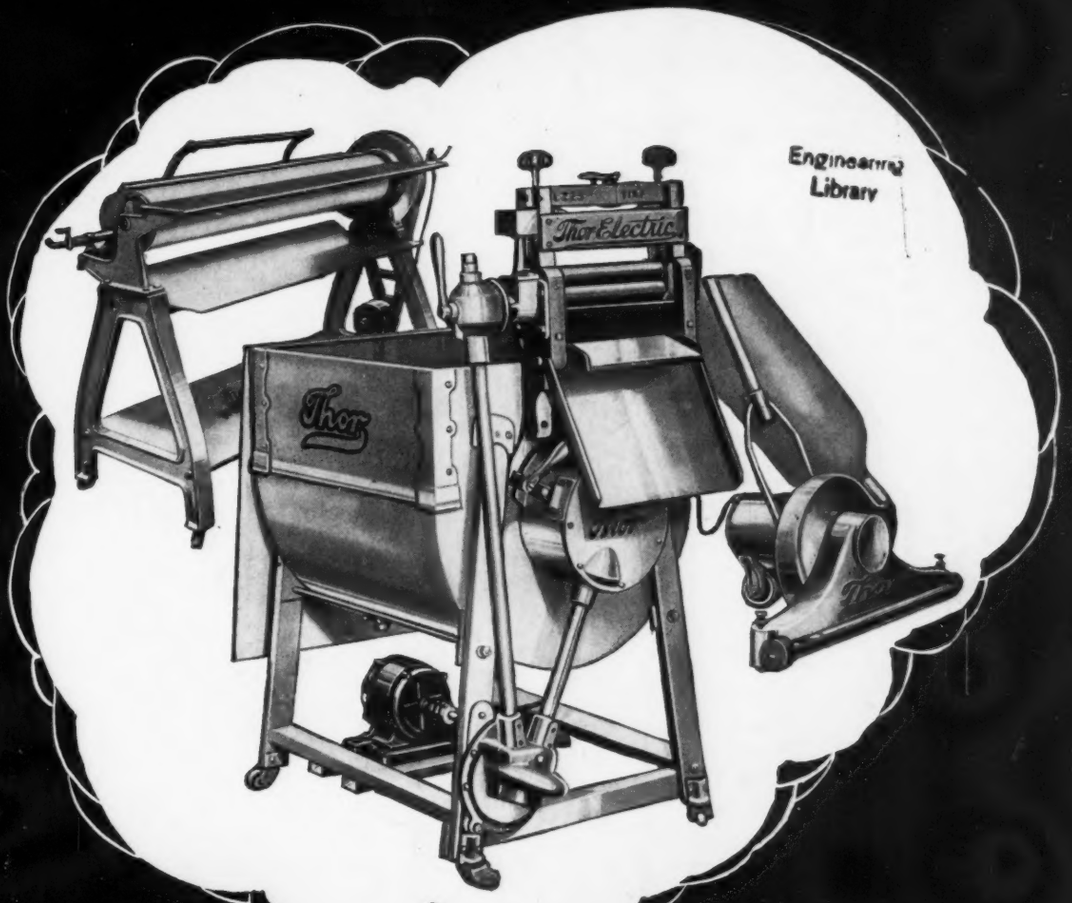

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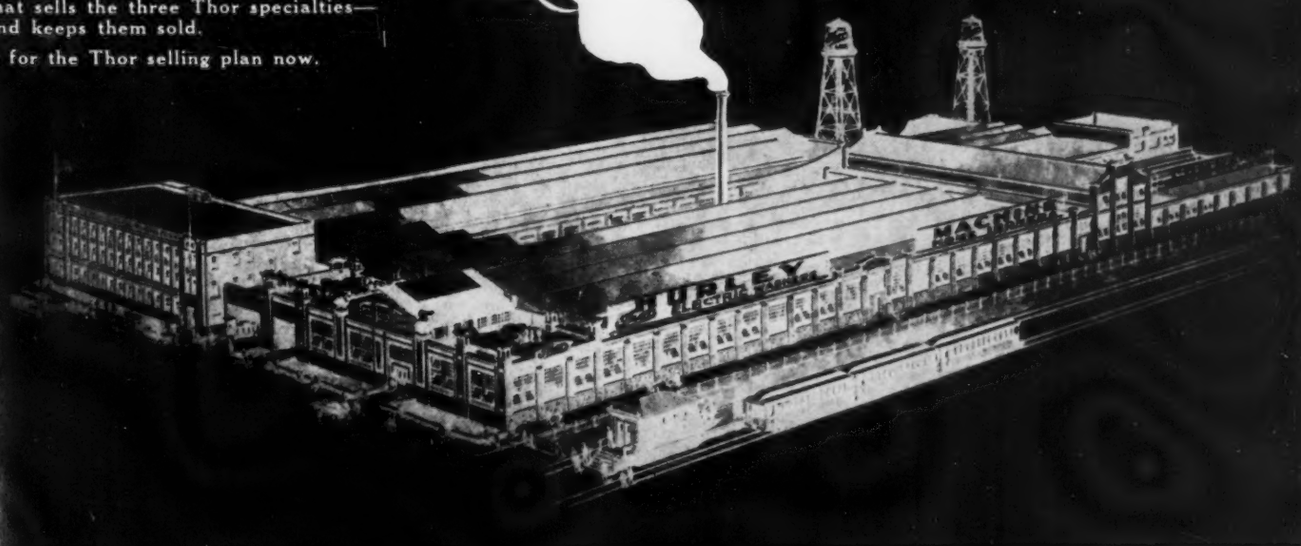

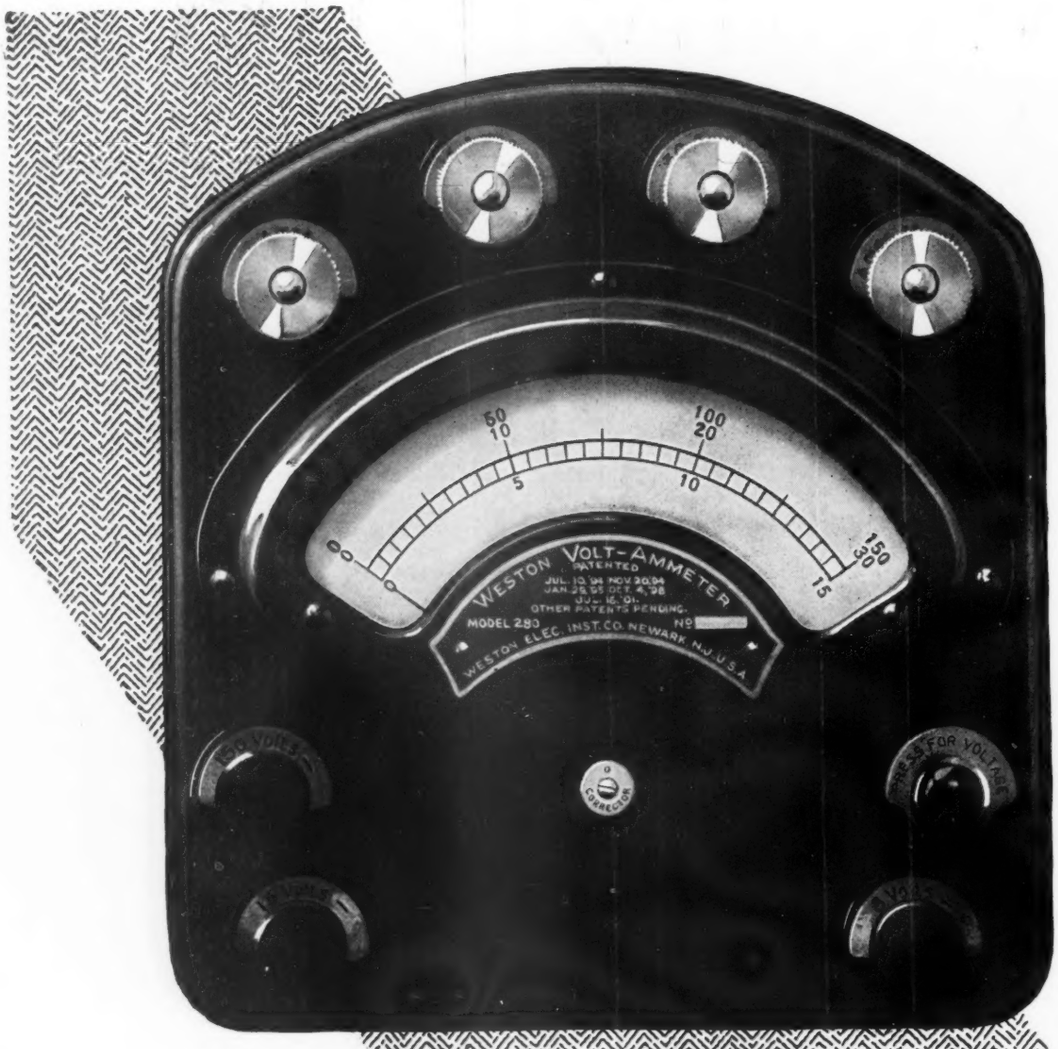

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Electrical World

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Coterminous Rates and Costs

A MOVEMENT to obtain lower prices and rates on the ground that certain raw-material costs have been reduced is a perfectly natural outcome of easier quotations. The manufacturer, whether of commodities or of electrical service, must be prepared to meet such demands frankly and to explain why in many cases he cannot immediately grant them. It will pay to take the purchasing public into one's confidence in this respect. In numerous cases the amount of raw material on hand, purchased at higher prices than now prevail, prevents prompt reductions in quotations or increases in discounts. Until a large part of this reserve stock is worked into commodities or into electrical energy, as in the case of coal, and such products are sold, it is manifestly only fair to permit prices to reflect the conditions under which the material was obtained. This applies to the large central station with its coal reserve painfully acquired in 1918 as well as to the producer of more tangible commodities. Progressive central stations will unquestionably share any substantial reductions in fuel cost which they may be fortunate enough to experience in future with their customers when the time is ripe for so doing, and far-sighted electrical manufacturers will be found in the same category in cases where existing labor costs, overhead charges and raw-material prices justify such action.

To everything there is a season, and a time to every purpose under the heavens. Experience shows that increasing rates become unprofitable and low rates yield large returns. Limits there are in both directions, and this the railways have learned to their sorrow. Electric light and power companies can profit greatly from the experience of the railway companies, because history often repeats itself.

Taxes to Meet Cost of Service

A DECISION of the Massachusetts Supreme Court on April 2 declared that if it shall become necessary to levy taxes to meet the full cost of service on the Boston Elevated Railway the action will be constitutional. The fundamental question presented to the court was whether the state has the power under the constitution to take over a public utility and operate it for so low a rate for service as to create a deficit and pay that deficit in the only way possible, out of taxation.

This decision is heartening to advocates of private ownership under public regulation who have feared that in cases where increased rates prove insufficient to meet full service costs utilities will be forced into public ownership in order that the required service may be rendered. The public service rendered by gas and electric utilities generally is as readily demonstrable as that furnished by transportation companies. Experience indicates that progressive increases in rates discourage patronage if carried far beyond the normal planes of current charging for service. If increasing cost of service wipes out the net revenue necessary to furnish a fair return on the legitimate investment, and if higher rates do not suffice to overcome this handicap, taxation must come to the rescue. That such a rescue may be effected without departing from the advantageous policy of private ownership, with its characteristic encouragement of initiative, is a welcome declaration.

Where are the pessimists who visioned loadless stations and bankrupt treasuries with the passing of war-order plants? Sound administration and the square deal are all that are needed to realize a continuity and expansion of service which will be a proud heritage to the industry's leaders who are to come.

Financing Extensions

THE report on financing line extensions which we publish this week was started by the National Electric Light Association committee as a war problem. Its sound principles, however, will stand the industry in good stead since peace brings with it conditions little less disturbed. The costs of labor, and to a less degree of material, are still up and are likely to remain so for a long time to come. This means that the cost of extensions continues to be high and, while the load taken on is likely to be of a more stable character, the initial expenditure must still be faced. In ordinary times, and even now, extensions into fairly homogeneous paying territory are a very simple matter, merely a phase of business-getting like the work of a skilled solicitor.

The real questions of equity arise when there is a call for extension into territory at present unproductive in behalf of a particular person. The customer is practically asking that the company shall carry in his sole behalf an abnormal amount of overhead and maintenance, and there is certainly justice in the contention that somehow he shall share this inevitable charge. The company may, and sometimes does, cheerfully waive its moral rights, particularly when future business is in sight. But in other cases cited in the report it cannot properly do so, and the form in which the customer should share the expenses becomes a matter of importance. In all instances a call for abnormal expense such as is incurred by laying cable in midwinter should be met by a reasonable charge therefor. Sharing the normal expense, however, is a more delicate problem. The two popular methods are to require a guaranteed income and to exact a suitable deposit as an earnest of

earnings on the extension. The former is akin to paying the freight on purchases above a certain fixed sum, the latter to a stiff return credit on containers, with the difference that in the case before us the two plans can really be used interchangeably. And there is the further distinction that he who returns the container is sure of getting his money back, while even on the showing of the committee the customer who pays a deposit is by no means sure of any return.

Frankly, as between the two plans here considered, we greatly prefer the first, both for simplicity and for moral effect. To guarantee a reasonable business to him who comes far and spends freely to get it is a thing which appeals to the sense of fairness lying at the bottom of all honest business. The deposit scheme looks to the man from Missouri like paying a round lump sum to the fellow who expects to make big profit out of the trade year after year. Of course, the latter plan may work out just as much to the customer's advantage as the former, yet we think that psychologically the guarantee plan is by far the sounder of the two. In the case of companies operating under rigid commission control still other factors enter. Much depends practically on the attitude of the commissions as to expenses that may be capitalized. As the report before us points out, the capitalization of an expenditure such as that for an extension means that the charge is spread over the whole business and the cost is really averaged over the community. This is in line with the general tendency toward demanding uniformity of charges as a matter of public policy. A company might say to a customer asking a long extension for service that on account of the extra expense he must be charged an extra sum per kilowatt-hour. On the theory of individualistic costs this demand would be justified, yet we doubt whether any commission would sponsor it. Between this and the doctrine of general average there are an indefinite number of compromises. Which of them is taken depends, in the last resort, on the attitude of the commissions, and they are as much at sea on the situation as are the operating companies themselves. Certainly work like that done by the N. E. L. A. committee in this carefully considered report will do much toward clarifying the issues.

Barring moderate reductions in the price of low-grade fuel, there is little encouragement for the belief that coal costs will drop sufficiently to justify holding back orders in the coming weeks. Waiting too long for prices to drop may result in the greatest local shortage in the history of that particular section.

Economic Use of Static Condensers

IN OUR last number Prof. Waldo V. Lyon discussed the economic feasibility of bettering the voltage regulation of transmission lines by connecting condensers to them. In this number he turns attention to the economic feasibility of increasing the output of alternators by connecting condensers to them.

To one who has not studied the subject it seems at first sight well-nigh incredible that if a central-station alternator is rated at, say, 1000 kva., or 1000 apparent kw., and if it is operated at this rated output under a low induction power factor, of say 0.5, then it is possible to double the commercial power delivery of the machine by connecting in static condensers at the switchboard to the extent of 866 reactive kw. The output of the alternator under the low power factor was only 500 active kw., and this was accompanied by a useless additional load of $+j866$ reactive kw. Installing condensers to the extent of $-j866$ reactive kw. would compensate and carry on the reactive load without any power loss, if the condensers were dielectrically perfect, leaving the total load on the alternator at 500 active kw. and 100 per cent power factor; so that additional load to the extent of 500 non-reactive or purely active kw. could be added without increasing the heating of the machine. In fact, the heating of the machine would probably be decidedly diminished with 1000 active kw. and no reactive load, because the excitation then required would be likely to fall far short of that necessary to deliver 500 active kw. and 866 inductively reactive kw. at the same rated terminal voltage.

In the case of an active load, or a load of active kilowatts, the power supplied by the alternator and its prime mover is released from the circuit as thermal, mechanical or electrochemical energy, which is supposed to be duly registered on the watt-hour meters for payment. In the case of a reactive load, or a load of reactive kilowatts, the power supplied by the alternator and its prime mover is just as truly power as in the case just considered, but it is not released from the circuit. It is merely occupied in transferring electric and magnetic energy from the alternator to parts of the circuit and back again, being outwardly directed, or positive, during one voltage quarter cycle and inwardly directed, or negative, during the next quarter cycle. The average effect of this in-and-out reactive power is zero, and it leaves the outward stream of active power unchanged in the long run. Nevertheless, the reactive power takes a corresponding reactive component of current to maintain it, and this contributes to heat up and fill up the armature. On a low power factor, an alternator may be heated up to the operating temperature limit largely by the reactive current for maintaining the reactive power of excitation magnetic fields in induction motors. Static condensers provide a bypass for this reactive power, so that they carry the reactive load and the alternator is freed from it.

Although no general rule may be laid down, it would appear that Professor Lyon makes a better economical showing for condensers as auxiliaries to a central-station alternator than as auxiliaries to power-distribution line conductors for diminishing their size. In cases where this is correct an explanation might be looked for in the fact that where condensers are installed merely to help a low-power-factor power-transmission line their cost can only be obtained from the saving in copper wire installation and maintenance. Where, however, condensers are installed to help a low-power-factor alternator, their cost can be obtained from the saving in installation and maintenance of both alternator and prime-mover plant.

An interesting practical question is raised in the article as to where the condensers should be connected to the low-power-factor system—at the power house, on the line or at the low-power-factor motor locations. There are various relative advantages to be considered in this question. At the power house the condensers may be easily inspected and perhaps easily housed. At the motor locations the condensers may be most effective, but they will be more scattered and their oversight may be more difficult.

Our Electrically Driven Superdreadnought

WE ARE glad to give some details of the equipment and performance of the great battleship New Mexico, the first of the electrically driven class. As our readers well know, electric propulsion for warships has been considered for more than a decade past and was tried in the collier Jupiter with excellent results before its more general adoption. The rationale of the electric drive is extremely simple—it arises from no obsession regarding the mysterious benefits of electricity, but merely from a well-founded desire to take advantage of the light weight and high efficiency of the steam turbine in a field where savings in dead weight and in fuel are all-important. The motor drive, then, is to be reckoned as essentially a speed-reduction gear, reducing the most efficient speed of turbine rotation to the most efficient screw speed. The electrical method has, too, the great advantages of giving a wide range of speeds at small loss of efficiency, and more important still, of giving complete freedom to the designer in the placing of the boiler plant and the turbo-generators. This gain, which will perhaps entirely revolutionize warship design, has not yet been worked out to its legitimate conclusion, and the successor to the New Mexico will have much to show us.

The main driving plant consists of two 13,500-kva. turbo-generators wound two-phase for 35 cycles and either 3000 volts or 4240 volts, as the armature connections may be switched in. Correspondingly, the four propeller motors have pole-shifting connections giving either twenty-four or thirty-six poles. These motors have double rotor windings and pole changing in the primary for the reason that the particular arrangement gave high efficiency at the two important speeds, 21 knots maximum and 15 knots for maximum cruising radius. The winding is actually a double squirrel cage, giving automatically high torque in starting and reversing. One of the very material gains of the system lies in the fact that full power is always available for reversing and the ship can pass from full driving power ahead to full driving power astern in twenty seconds. It is worth noting that in motor and generator design for this purpose it is the joint performance of the pair that is vital, and the result is that neither generators nor motors have exactly the same characteristics as if planned for general use apart, but are complementary to each other, with joint efficiency both in power and weight as the essential feature.

As a matter of fact, the highly successful tests made on the New Mexico tell only a part of the story. The really great gain in the adoption of electric drive is the freedom of placing the driving machinery. In previous battleships the great machinery spaces, always in about the same location from necessity and easy targets for shell or torpedo, have been the danger spots in action. This is grimly proved by the many stout British warships that were sent down by U-boats or gun fire. Now the machinery space can be subdivided far more completely than has before been possible, the units installed where they are far better protected, and above all the several parts of the power equipment scattered where no single explosion can put the whole out of business. We are coming to higher speeds and greater power than ever, so that the relative amount of driving machinery is always on the increase; hence there is the more difficulty in settling upon a safe and efficient design. We feel convinced that the adoption of motor drive, as in the New Mexico and sister ships, is the key to success in future warship design, the more so since our American battleships have to be planned for a big cruising radius as well as the highest practicable speeds and have customarily, through the whole history of our navy, had exceptional battery power given to them as well. We congratulate the navy and the designers on a very notable achievement in our country's behalf.

We are well advanced in a year when there is no government agency looking out for the coal needs of particular sections of the country. Procrastination in buying coal for next winter's service is risky in view of the let-down in production which has been experienced at the mines since the signing of the armistice.

Switch and Bus Structures

WITH the coming of the huge turbo-generator and the super-power station the bus structure has passed from the realm of mechanical design into that of architecture. There are certain practical problems in which, unlike ordinary mathematical operations, the form of the solution depends on the numerical magnitudes of the quantities involved. Such a situation is found in the planning of a modern bus structure, and no better illustration can be found than in the paper by C. D. Gray and M. M. Samuels in the current issue. In the regulation power house of the present day all the units are customarily run in parallel, and if a fault develops in one of them the output, not of that particular unit, but of the whole power station, is involved, so that the current-breaking capacity at each generator must be able practically to handle the whole output of the station without wincing.

It is interesting to note the description here given of some of the extremely heavy-duty circuit breakers which have been evolved to meet the existing demand. A rupturing capacity of some 600,000 kva. implies apparatus built for conditions so extraordinary that it cannot be tested under its working load, and this in turn means that the designer has to play safe; so that it would not be surprising if at a pinch these huge units could do better than their nominal rating. We think the authors do well in this connection to sound a warning note as to attempting too much in the way of compactness, not an uncommon fault in circuit breakers and switchboards generally. Plenty of room may mean security from serious accident, and it furnishes valuable insurance at low cost. The disconnecting switch for circuit breakers of great output is an accessory deserving attention, and the point here made, that the whole set of disconnecting switches should be operated by a single handle, and that handle locked, is altogether pertinent, as is the use of indicator lamps to insure clear circuits before disconnecting switches are operated. Indeed, it might not be a bad idea to have these lamps electrically interlocked with the disconnecting switches so that they could not be cleared for action until free of current.

All such apparatus as that here considered should be built into substantial masonry structures, the present tendency being toward the use of pressed brick. Busbar supports have not only to be strong in themselves but substantially set in the walls of the compartments, since with the enormous currents possible on short circuit the electrodynamic forces rise to astonishing amounts.

Economic Use of Static Condensers—II

Solution of Problem of Increasing Capacity of a Generating Plant by Using Static Condensers to Correct Power Factor—Determination of Feasibility of Putting Less Generating Equipment in New Plant by Using Condensers

BY WALDO V. LYON
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THE feasibility of improving the voltage regulation of a transmission line by the use of static condensers, as compared with increasing the line copper, was dealt with in the first installment of this paper. Equations were also proposed by means of which to determine whether line losses can be economically reduced by the installation of condensers. In this issue the use of static condensers for increasing the capacity for load of a generating plant whose output is limited by low power factor of the load is considered. The case of a new plant in which it is proposed to provide for static condensers in order to obviate the purchase of excessive generating equipment is also taken up.

INCREASE IN GENERATOR CAPACITY

Consider a station delivering its full-load current at a rather low power factor. If there is a further demand for power, is it economically feasible to add a condenser and supply this additional load without having the generated current exceed its full-load value? In Fig. 5 I_o is the full-load current which the generating station is delivering at a lag angle of θ. The additional current that is demanded is at a lag angle α. When this additional current is I, the condenser must take a current I_c in order that the resultant generated current shall still be its full-load value, I_o. The resulting power-factor angle is diminished to β. We will assume that I_o and I are fixed as long as the condenser is connected to the circuit. If the added load, I, is taken off, the condenser may be left in the circuit, since it will then reduce the generated current and thus cut down the copper losses. The general relations between these currents and power-factor angles are

$$I_o \cos\theta + I\cos\alpha = I_o\cos\beta. \qquad (8)$$

$$I_o\sin\theta + I\sin\alpha - I_c = I_o\sin\beta. \qquad (9)$$

The annual profit that is effected by the use of the condenser is

$$P = pVI\cos\alpha - qVI\cos\alpha - SVI_c - F.$$

p is here the income per watt-year for the additional power, and q is the cost of generating it. There may be a difference in opinion as to whether q should include anything other than the actual annual cost of generating the additional power; *i.e.*, the cost of fuel, water and so forth. The annual cost of the condenser is $SVI_c + F$. Let $p - q = Q$, the net income per watt-year in dollars. The annual profit may then be expressed as

$$P = QVI\cos\alpha - SVI_c - F. \qquad (10)$$

The profit will have its greatest value when

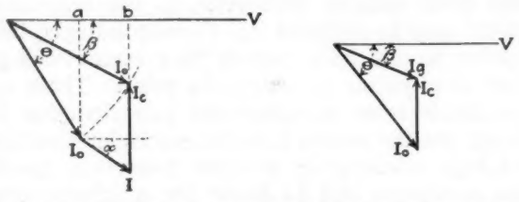
$$\partial P/\partial\beta = O.$$

This condition gives the simple relation that the profit is greatest when the resulting power-factor angle, β, is such that

$$\tan\beta = S\cos\alpha/(Q\cos\alpha - S\sin\alpha). \qquad (11)$$

Notice that this angle, β, depends only upon the power factor of the added load, the net income per watt-year on this load and the "slope cost" of the condenser. If the ratio S/Q is so large that $\beta = 0$, the addition of a condenser will cause the profit to decrease continually from its initial value, which depends upon the amount of the fixed charge, F. When β equals 0, I_c equals zero, and the profit equation reduces to: $P = -F$. Thus it only pays to add condensers when S/Q is less than $\cos\alpha\sin\theta/\cos(\theta - \alpha)$. If the added load has the same power factor as the initial load, S/Q must be less than $\sin\theta\cos\theta$. If the added load consists wholly of lamps taking current at unity power factor, S/Q must be less than $\tan\theta$. The greatest "slope cost" of the condensers that permits of their use depends upon the net income per watt-year from the additional power sold, the power factor of the original load and the power factor of the added load.

If the value of β from (11) is substituted in the



FIGS. 5 AND 6—VECTOR DIAGRAMS SHOWING RESULTS OF POWER-FACTOR CORRECTION

(5) Possible to add to the load by amount *ab*.
(6) Reduction in size of generator required from I_o to I_g.

general equations (9) and (10), the values of the added load and the condenser volt-ampere capacity which produce the greatest profit are obtained. The added watt load is

$$VI\cos\alpha = VI_c\left(-\cos\theta + \frac{\cos\alpha - k\sin\alpha}{\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2}}\right), \qquad k = \frac{S}{Q} \qquad (12)$$

The necessary volt-ampere capacity of the condenser is

$$VI_c = \frac{VI_o}{\cos\alpha}\left(\sin(\theta-\alpha) + \frac{\sin\alpha\cos\alpha - k}{\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2}}\right) \qquad (13)$$

The maximum profit is now obtained by substituting these values of the load and condenser currents in the general equation for the profit. The maximum profit is found to be

$$P_m = \frac{QVI_o}{\cos\alpha}\left(\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2} - \cos\theta\cos\alpha - k\sin(\theta-\alpha)\right) - F \qquad (14)$$

If the fixed cost of the condenser, F, is so large that this value of the greatest profit is zero or negative, the use of a condenser will involve a loss. Thus if the "slope cost" and "fixed cost" of the condenser are equal to or greater than the following critical values, there will be a loss if a condenser is used to correct the power factor.

$$\text{Critical } S = Q\frac{\cos\alpha\sin\theta}{\cos(\theta-\alpha)} \qquad (15)$$

$$\text{Critical } F = \frac{QVI_o}{\cos\alpha}\left(\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2} - \cos\theta\cos\alpha - k\sin(\theta-\alpha)\right) \qquad (16)$$

Notice that the critical value of the "fixed cost" of the condenser depends not only on the net profit on the additional power sold, the "slope cost" of the condenser and the power factors of the initial and added loads, but also upon the volt-ampere capacity of the station. Thus even if the "slope cost" is below its critical value, the "fixed cost" will prohibit the use of a condenser unless the capacity of the station is sufficiently great.

If the use of a condenser in the generating station for increasing its watt output proves to be economical, the question arises whether or not there will be an added saving with the condensers out on the line. If the increased fixed cost, due to housing and attendance or automatic operation, is less than the saving in line copper loss, it will prove advisable to remove the condenser from the generating station to some point out on the line determined by the principles discussed under "Reduction in Copper Loss."

Example 3.—A load of 600 kw. at 0.5 power factor, 13,200 volts, three-phase, is delivered to a circuit. Added load at 0.7 power factor is demanded. Assume that the cost of condensers installed is $18 per kva. and that the charges under items (1) and (2), interest and depreciation, are 12 per cent. Assume that the net income per kilowatt-year for the added load is $10. By (15) the critical value of S is $(0.7 \times 0.866)/0.96 \times \$10 = \$6.25$ per kva. Actual value of S is $0.12 \times \$18 = \$2.16$ per kva.

From (11) the resulting power factor is 0.96.

In equations (12) to (16) inclusive $S/Q = 2.16/10 = 0.216 = k$.

To determine the added load and condenser capacity for maximum profit:

By (12) the added load is

$$\frac{600}{0.5}\left(-0.5 + \frac{0.7 - 0.216\times 0.714}{0.567}\right) = 556 \text{ kw.}$$

By (13) the necessary capacity of condenser is

$$\frac{1200}{0.7}\left(0.249 + \frac{0.7\times 0.71 - 0.216}{0.567}\right) = 1290 \text{ kva.}$$

By (16) the critical value of F is

$$\frac{\$10\times 1200}{0.7}\left(0.567 - 0.5\times 0.7 - 0.216\times 0.249\right) = \$2{,}800.$$

If the annual charges for housing and attendance are $800, there will be a net yearly profit of $2 800 — $800, or $2,000.

At $18 per kva. the first cost of the condensers is $1290 \times \$18 = \$23{,}220$.

If new generating equipment is added at the station to furnish the same load that the condensers allow, the additional equipment must have a capacity of 710 kva. At a first cost equal to that of the condensers this is $33 per kva. But the cost of generating equipment may include the cost of building addition, of increased boiler capacity, switchboards, transformers and line copper and possibly additional charges for attendance. With condensers out on the line all of the copper losses will be about 40 per cent of what they would be if generating equipment were added to supply the added load.

Reduction in Equipment

The last case to consider is that in which a condenser is used to reduce the size of the necessary equipment in a new installation. In order to be conservative we shall disregard the beneficial effect that the condenser will produce in reducing all losses, even if this is the determining factor. The annual cost of the generating and transmission equipment should be analyzed and plotted just as was done for the condenser (see Fig. 1). With the condenser in the generating station the cost for housing and attendance is largely offset by similar charges on the generating apparatus it displaces. If the condenser is placed out on the line, however, the capacity required in line copper and the transformers will be materially reduced. Each of these installations should be investigated and compared. In either case the "slope cost" and "fixed cost" of generating and transmission equipment should include all of that up to the point at which the condenser is installed. Fig. 6 shows the vector diagram which applies to this problem. There is a load demanding a current of I_o at a lag angle of θ. If a condenser taking a current of I_c is installed, the generated current may be reduced to I_g at a lag angle of β. The annual profit is the difference between the cost of generating and transmission equipment corresponding to a current of I_o and the combined cost of similar equipment for a current, I_g, and of a condenser which will take a current I_c. That is:

$$P = S_{go}VI_o + F_{go} - \{S_gVI_g + F_g + S_cVI_c + F_c\} \qquad (17)$$

The subscripts g and c show whether the costs refer to the generating and transmission equipment or to the condensers.

The fundamental relation between the currents, from Fig. 6, is

$$I_o\cos\theta = I_g\cos\beta \qquad (18)$$

$$I_o\sin\theta - I_c = I_g\sin\beta \qquad (19)$$

For a maximum profit $\frac{\delta P}{\delta\beta} = 0$. This gives the simple relation that $\sin\beta = S_c/S_g$ when the profit is greatest. A condenser should not be used if S_c/S_g is equal to or greater than $\sin\theta$. That is, if used for no other purpose than to reduce the necessary capacity of generating equipment the first cost of condensers must be considerably less than the first cost of generating equipment. With turbo-alternators complete at $12 or $13 per kilovolt-ampere and condensers at $16 per kilovolt-ampere, the use of the latter to replace the former is hardly economical.

For the condition of maximum profit the saving in equipment capacity is:

$$VI_o\left(1 - \frac{\cos\theta}{\sqrt{1-a^2}}\right) \text{ volt-amperes, where } S_c/S_g = a \qquad (20)$$

The condenser capacity required is:

$$VI_o\left(\sin\theta - \frac{a\cos\theta}{\sqrt{1-a^2}}\right) \text{volt-amperes.} \qquad (21)$$

If these values are substituted in the general equation for the profit, its maximum value is found to be

$$P_m = VI_o\left\{S_{go} - S_g\frac{\cos\theta}{\sqrt{1-a^2}} - S_c\left(\sin\theta - \frac{a\cos\theta}{\sqrt{1-a^2}}\right)\right\} + F_{go} - F_g - F_c \qquad (22)$$

The "fixed cost" of the condenser, F_c, must be less than a value which would make the maximum profit equal to zero.

The critical values of the "slope cost" and "fixed cost" of the condenser are in this case

$$\text{Critical } S_c = S_g \sin \theta \qquad (23)$$

$$\text{Critical } F_c = VI_o\left\{S_{go} - S_g\frac{\cos\theta}{\sqrt{1-a^2}} - S_c\left(\sin\theta - \frac{a\cos\theta}{\sqrt{1-a^2}}\right)\right\} + F_{go} - F_g \qquad (24)$$

The accuracy of these calculations depends entirely upon the accuracy with which the various cost items are determined. This is indeed the crux of the whole problem and should be treated as such.

Example 4.—A new installation requires 500 kw. at 0.4 power factor. Assume that with condensers in the generating station the fixed charges on generating equipment and condensers offset one another; viz., $(F_{go} - F_g - F_c) = 0$ in equation (22). Assume that the first cost of low-speed generators and auxiliary equipment is $21 per kva. and that of condensers is $16 per kva. Assume that the annual charges for interest, depreciation, taxes and insurance are 13 per cent on the generating equipment and 11 per cent on the condensers.

By (23), critical $S_c = \sqrt{1-0.4^2}\ S_g = 0.916 \times 0.13 \times \$21 = \$2.50$ per kva.

Actual $S_c = 0.11 \times \$16 = \$1.76$ per kva.

In equations (20) and (24) $S_c/S_g = a - 0.645$.

Saving in generating equipment is by (20)

$$\frac{500}{0.4}\left(1 - \frac{0.4}{\sqrt{1-0.645^2}}\right) = 596 \text{ kva.}$$

Necessary capacity of condenser is by (21):

$$\frac{500}{0.4}\left(0.916 - \frac{0.645 \times 0.4}{\sqrt{1-0.646^2}}\right) = 722 \text{ kva.}$$

The annual profit is:

$$\frac{500}{0.4}\left(2.73\left(1 - \frac{0.04}{\sqrt{1-0.645^2}}\right) - 1.76\left(0.916 - \frac{0.645 \times 0.4}{\sqrt{1-0.645^2}}\right)\right) = \$360.$$

CHART TO FACILITATE THE DESIGN OF LIGHTING SYSTEM

Special Consideration of Each Case Preferable, but Approximate Solution Is Given by the Diagram

NUMEROUS charts, short cuts and graphical methods have been developed to facilitate the selection and layout of lighting units for any given conditions, but their use has so often required the arbitrary assumption of so many important factors that they are of little value. Others are so lacking in supplementary notes regarding their limitations that they are objectionable because they tend to make rule-of-thumb problems out of illumination calculations that ought to involve engineering judgment.

While any chart that may be developed for this purpose would probably have this objection, the accompanying one, included in the Industrial Lighting Code issued by the Industrial Commission of Wisconsin and prepared by Arthur J. Sweet, is deserving of consideration. Some of the instructions which must be followed in using the chart are given in the paragraphs which follow here.

Height of Lamps.—In general it will be found desirable to mount lamps as high as possible. The chief exceptions to this general rule consist of those cases where the ceiling is very high relative to one dimension of the floor area and where horizontal beams, belting or the like form a network at some distance below the ceiling. Save for these exceptions and possibly for some rare conditions of construction (such as use of indirect lighting) the lamps should be mounted as close as possible to the ceiling. Incandescent lamps can generally be mounted directly on the ceiling, thus bringing the light center from 6 in. to 12 in. (15 cm. to 30 cm.) below the ceiling.

There are two chief advantages of mounting lamps as high as possible. First, higher mounting heights permit the use of wider spacings with equally good distribution of the light, such wider spacings in turn resulting in the use of a smaller number of lamps of larger size. This means lower installation and operation costs. A second advantage is that high lamps are less likely to come within the direct field of vision, and hence are less likely to be a source of eye fatigue and eyestrain to the worker.

APPROXIMATE RATIO BETWEEN THE VERTICAL AND THE HORIZONTAL ILLUMINATION

Type of Reflector	Vertical Illumination in Per Cent. of Horizontal Illumination	Correction Factor to Be Applied to Size of Lamp When Chart I Is Used for Vertical Illumination Determination
Deep-bowl prismatic-glass reflector	100	1.0
Shallow-bowl porcelain-enameled metal reflector	70	1.4
Deep-bowl mirrored-glass reflector	60	1.7
Shallow-bowl porcelain-enameled reflector—lamp fitted with shield or cap	55	1.8
Deep-bowl porcelain-enameled metal reflector	50	2.0

Spacing Between Lamps.—The left-hand portion of the chart is employed to determine the proper spacing between lamps when the height of the ceiling can be taken as the approximate height of the lighting unit. Of course, where the lamps are mounted some distance below the ceiling their height above the floor should be considered in using this chart. The method of making a determination is illustrated by the arrows for a particular case in which the ceiling height or the mounting height of the fixtures is 12½ ft. (3.75 m.).

The intersection of the vertical line with the first and last horizontal lines indicates on the bottom scale the closest and widest spacings allowable respectively. The best spacing will be the minimum of these values—in this case 11 ft. (3.4 m.). If the work is of an exacting character, the spacing should approximate the best value; in this case it should not be greater than 13 ft. (4 m.). If the work is not of an exacting character, a wider spacing may be employed, but not greater than the maximum amount which is indicated by the lighting chart.

The exact spacing adopted will generally depend upon the dimensions of the building structure. Thus in the case of the ceiling height assumed, and with bays measuring 22 ft. (6.7 m. by 7.9 m.), lamps would preferably be placed on 11-ft. (3.4-m.) centers in one direction and on 13-ft. (4-m.) centers in the other, thus providing four lamps per bay.

The accompanying curves are based on the illumination intensity 3 ft. (1 m.) above the floor. However,

the data are sufficiently accurate for a working plane 2½ ft. (0.8 m.) above the floor in a relatively small office interior. These are also sufficiently accurate for lesser distance than 3 ft. (1 m.) from the floor in large interiors.

Size of Lamp.—The right-hand portion of the chart is for determining the size of lamp necessary to produce the specified intensity of illumination. Thus, under the conditions of installation assumed before, with lamps spaced 11 ft. (3.4 m.) apart in one direction and 13 ft. (4 m.) apart in the other, the average spacing between lamps is 12 ft. (3.7 m.). Let it be assumed

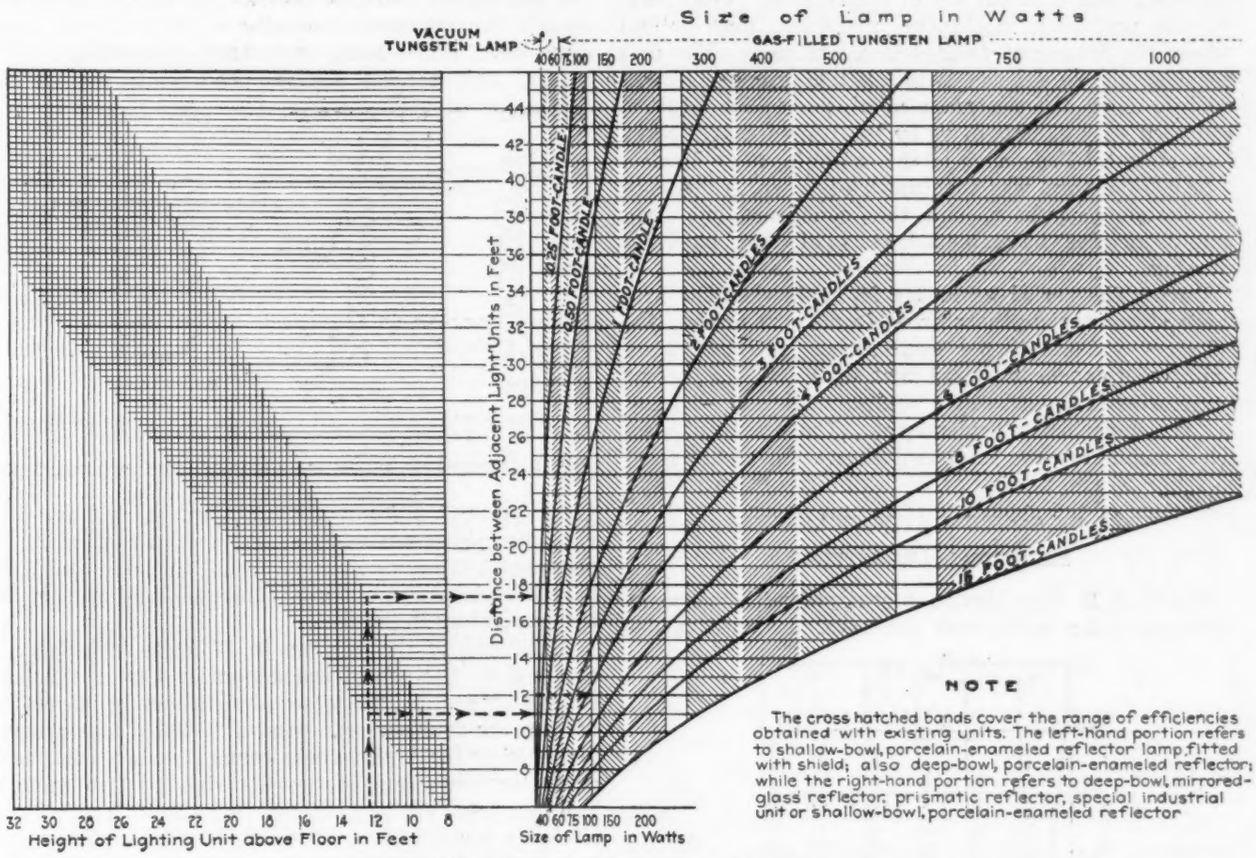

Size of Lamp in Watts
VACUUM TUNGSTEN LAMP
GAS-FILLED TUNGSTEN LAMP
40 60 75 100 150 200 300 400 500 750 1000
0.25 FOOT-CANDLE
0.50 FOOT-CANDLE
1 FOOT-CANDLE
2 FOOT-CANDLES
3 FOOT-CANDLES
4 FOOT-CANDLES
6 FOOT-CANDLES
8 FOOT-CANDLES
10 FOOT-CANDLES
15 FOOT-CANDLES
Distance between Adjacent Light Units in Feet
44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8
32 30 28 26 24 22 20 18 16 14 12 10 8
Height of Lighting Unit above Floor in Feet
40 60 75 100 150 200
Size of Lamp in Watts
NOTE
The cross hatched bands cover the range of efficiencies obtained with existing units. The left-hand portion refers to shallow-bowl, porcelain-enameled reflector lamp fitted with shield; also deep-bowl, porcelain-enameled reflector; while the right-hand portion refers to deep-bowl, mirrored-glass reflector, prismatic reflector, special industrial unit or shallow-bowl, porcelain-enameled reflector

CHART TO FACILITATE THE DESIGN OF LIGHTING SYSTEMS

that the work is of such a character that an illumination of 4 foot-candles (43 lumens per sq.m.) is to be provided. Following the horizontal line representing a 12-ft. separation to its intersection with the curved line representing 4 foot-candles, the cross-hatched band representing a lamp with the rating of 100 watts will be encountered.

Since the intersection falls on the right-hand side of this band, it means that the more efficient types of reflectors will have to be employed if the desired illumination intensity is desired. If the relatively inefficient reflectors are used, the intensity obtained will be less than 4 foot-candles. In other words, the band representing each size of lamp is based on the ordinary efficiencies that obtain, the left-hand side of each band referring to the low-efficiency reflectors and the right-hand side to the high-efficiency units with intermediate grades between.

The charts allow for 30 per cent depreciation in light intensity due to dirt on the reflector or lamp or to deterioration of the filament. If reasonable maintenance which will prevent reduction greater than this cannot be maintained, larger lamps than those indicated in the chart should be used.

It must be clearly realized that the chart determines the size of lamp with reference to horizontal illumination (that is, illumination on a horizontal plane). If the work be chiefly on a horizontal plane, the chart may be directly used to determine the proper size of lamp with reasonable accuracy and exactness. If, however, the work be chiefly in some vertical plane, the problem of proper lamp size becomes much more complicated and can be only roughly determined by any general data. The ratio between the horizontal illumination and vertical illumination depends chiefly on two factors—(a) to what degree the light units are in front of the work, so that the light can illuminate the face of the work, and (b) the type of reflector employed. The first of these factors so depends upon local conditions that no general data or value can be given.

As regards the second factor, the approximate ratios between the vertical and horizontal illuminations are given for the various distinct types of reflectors in the accompanying table. These relations are necessarily approximate since they vary considerably with varying conditions of installations. They vary but slightly, however, in different makes of the same type of reflector.

John A. Hoeveler is illuminating engineer of the Industrial Commission of Wisconsin and was instrumental in the preparation of its lighting code.

Electric Drive of the U. S. S. New Mexico

Space and Efficiency Are Prime Considerations in Design of Shipboard Drive — Flexibility Provided on New Mexico by Dividing Machinery Into Two Parts, and Ship Makes Seventeen Knots with Half of Machinery Disabled

PROBABLY the most important advantage of electric drive for warships is the flexibility of the driving machinery whereby the ship can cruise, at reduced speed, even when a considerable part of the apparatus has been put out of commission. Vital parts of the propelling machinery, moreover, may be put where the danger of damage is a minimum. The first considerable experience with electric propulsion was derived from the performance of the collier Jupiter, equipped with electric drive by the United States Navy Department. The design of the battleship New Mexico, a 32,000-ton ship, was then undertaken with confidence in electric propulsion, and this confidence has been amply justified by extended tests of that powerful warship.

During the period beginning in 1903, when the first large steam turbo-generator was put into service, the efficiency and weight per kva. of these sets have been improved to such an extent that their use has become possible on shipboard where weight, space and efficiency are the important considerations. The design of electrical machinery for shipboard thus requires attention to these factors as well as to flexibility of control and protection of the apparatus from salt water.

ELECTRICAL DESCRIPTION

The U. S. S. New Mexico is equipped with two main turbo-generator units, each generator designed to de-

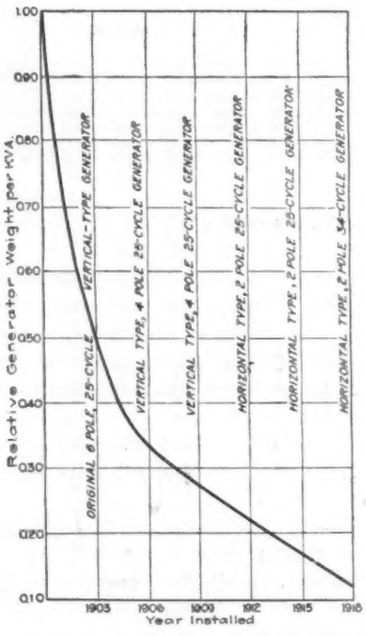


FIG. 1—IMPROVED WEIGHT ECONOMY IN TURBO-GENERATORS

velop 10,500 kw. at 78 per cent power factor and 13,500 kva. at full speed of the ship and to carry a 25 per cent overload (16,850 kva. at 78 per cent power factor) for four hours. The rotors have two poles and a maximum rotative speed of 2100 r.p.m., which corresponds to a frequency of 35 cycles. The stators are wound two-phase with leads brought out from the beginnings and endings of each phase to an eight-pole, double-throw disconnecting switch placed in the main circuit between the generators and the motors. By manipulating this switch two generator connections (Fig. 2) are available—first, diametrical, two-circuit, low-voltage (3000 volts), and, second, square, one-circuit, high-voltage

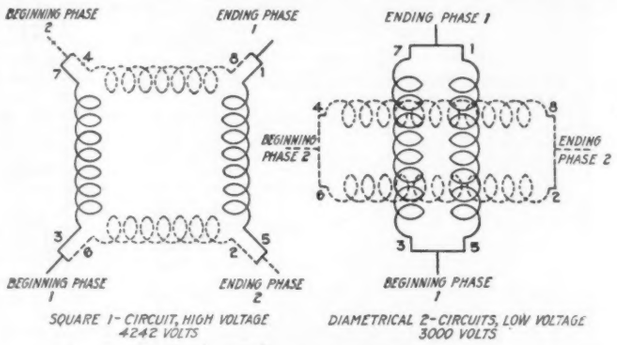


FIG. 2—GENERATOR WINDINGS ARRANGED FOR TWO VOLTAGES

(4240 volts). With a constant flux the voltage will vary directly or inversely as the square root of 2, depending on the connection involved. Suitable interlocks have been installed, making it impossible to operate the two generators in parallel.

All speeds of the ship up to 17 knots inclusive are obtained by the use of one generator having the low-voltage connection, the generator furnishing power for driving the four motors. Above 17 knots two generators having the high-voltage connection are used, each generator furnishing power for driving two motors. The generator efficiency curve shows a uniformly good efficiency throughout a wide range of load. The main turbo-generators are used only for propelling the ship and are in no way connected to the lighting or other auxiliary power circuits. Therefore it is possible under the varying conditions of load to adjust the voltage and current to obtain good efficiency.

The induction motors, directly connected to the ship's propeller shafts, are two-speed motors with connections for twenty-four and thirty-six poles. The speed reduction between the generators and the motors when using the twenty-four-pole motor connection is twelve to one, and with the thirty-six-pole connection, eighteen to one. Hence, the extreme range of generator r.p.m. for the specified operating speeds of the ship, 10 to 21 knots, is approximately 1440 r.p.m. to 2100 r.p.m.

GENERATOR CHARACTERISTICS

The New Mexico generators are conservatively designed. Compared with the maximum rated machines for land practice, the relative armature reaction is considerably lower and the densities in the magnetic section are slightly higher. Test data show that the generators are not working at the peak of the kilowatt curve, but at a safe distance down where there is suf-

ficient margin in power to take care of the rudder swings and heavy seas. Based on the maximum power factor of the motors, 79 per cent, the generators have a margin in power of 24 per cent.

A very important feature inherent with electrical propulsion is that full power is always available for either direction of propeller rotation. From actual reversal tests, at maximum speed of the ship, the observed excess excitation current required for reversal was approximately 60 per cent above that for the steady running condition. The line current increased to approximately three times the steady running value. That these high values of current are not injurious to the generator is due to the extremely short time required for reversal and the large heat-storage capacity in the generator. The observed time for reversal from maximum speed ahead to full reversing speed astern, with the motors in the thirty-six-pole or low-speed connection, was approximately twenty seconds. To pull the motors into step in the reversed direction of rotation required holding the over-excitation on the generator fields approximately eight seconds, the rest of reversal time being consumed in the release of the interlocks and in the switching operation.

The mechanical design of the generator is similar to that of machines developed for central stations in most respects. One feature that differs from land practice

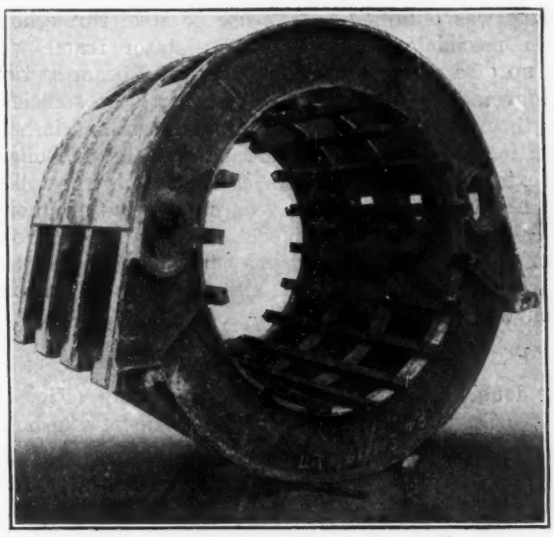


FIG. 3—I-BEAM CONSTRUCTION OF GENERATOR FRAME

is the omission of the turbine and generator base castings. The turbine casing, generator stator frame and bearing standards are bolted directly to a stiff structural steel foundation, which is securely tied in with the ship's structure.

The stator or armature is of a compact design. The stator frame is of the sectionalized I-beam type, which consists of several circular I-section castings, properly spaced and held together at their outer periphery by boiler plates, these plates being hot-riveted to the I-section castings. The I-section castings after being properly spaced and supported are carefully bored out at their inner periphery for the attachment of rectangular steel bars, these bars forming the dovetail ribs for assembling the stator core punchings. The advantage of this frame over the solid cast type is the great saving in weight, it being approximately one-half as heavy. Other advantages are the elimination of dangerous shrinkage strains always present in the solid cast frames, the simplified patterns and castings and the general adaptability for shortening or lengthening and respacing of dovetail ribs to suit the various punching segments.

INSULATION PROBLEM

Stator coils are of the conventional barrel type, but special precautions have been taken in the matter of their insulation. Recognizing the severe conditions that would be imposed on the insulation by the salt-laden ventilating air, waterproofing insulation treatments were applied to the coils, special attention being directed to the connections and to the portions of the coils beyond the stator core. By heat treatment the insulation of the coils is prevented from loosening under the most severe operating conditions. Similar treatment was also accorded the rotor windings.

The turbo-generators are ventilated by two duplicate and separate ventilating systems, one for the starboard generator and the other for the port. The air is taken from out of doors through ducts placed just back of the upper superstructure on the starboard and port sides. The openings in these ducts face aft and are approximately 10 ft. (3 m.) above the main deck floor and are designed to prevent the entrance of rain. Auxiliary blowers of ample capacity draw in the air through these openings and force it down to the bottom of the ship into chambers directly under the generators. These chambers and the air connections to them are made watertight, and the danger of bilge drainage entering with the air into the generator windings is practically eliminated. Fans mounted on each end of the generator rotor take the air from these chambers and force it axially through the various ventilating paths in the machine.

TYPE OF MOTOR SELECTED

Although wound-rotor induction motors with resistance control were used successfully on the Jupiter, induction motors with double rotor windings and pole-changing arrangement in the primary were selected for the New Mexico. For this application the highest possible economy was desired at the two most important speeds—high speed with full power at 21 knots and medium speed at 15 knots where the maximum cruising radius without refueling is of the greatest importance. With these requirements it was evident that for the most economical operation a changeable-pole motor giving a speed ratio of two to three was desirable on each shaft, the four motors at full speed taking power from two generators and when cruising from one generator. By changing the poles on the motor the proper speeds of the screw are obtained with a maximum speed of the generator, thus giving low steam consumption on the turbine in both cases.

Since the motors and generators of the New Mexico were to be especially built to operate together, more liberty in design was allowed. A new type of winding was designed, the coils of which were so grouped that a change in the connection at the motor terminals would give a balanced quarter-phase distribution for either twenty-four or thirty-six poles. This gives a simpler control than if the motor were wound three-phase. In addition, since the four motors receive power from two generators at full speed and one generator at cruising speed, the best combined operation is obtained with a

decreased voltage on the thirty-six-pole combination. This also works out best for a quarter-phase winding. By connecting the generators in square connection for high speed and parallel connection for low speed the correct ratio of operating voltage is obtained.

The torque requirements derived from actual experiments on the Jupiter, supplemented by tank trials, showed that a resistance inserted in the rotor winding would be required only for a few seconds at a time—that is, during starting or upon reversal—in order to obtain quick possession of the screw and bring it up to speed. With this in mind a double squirrel-cage type of motor was adopted, thus eliminating the rheostat. The outer high-resistance, low-reactance winding takes the place of the rheostat when starting and reversing. The inner low-resistance, high-reactance winding is the running winding when the motor is up to speed. The inductive action between these two cages is such that when the frequency in the rotor is high, as at starting or reversing, the current is choked back in the low-resistance winding, thus forcing a large percentage of the current through the high-resistance and producing adequate torque. As the motor speeds up the rotor frequency drops off and the inductive effect on the inner winding decreases, allowing the current to increase with a corresponding decrease in the outer winding until at slip frequency practically all of the current passes through the low-resistance cage. By this construction the torque advantage of a high-resistance rotor is obtained with the low slip and high efficiency of the low-resistance type of rotor when at full speed.

SHIPBOARD MOTOR DESIGN

The design of motors for use on shipboard differs very materially from those for ordinary commercial use. For the latter the question of size and weight is of minor consideration while for ships it is a vital one. On land a motor is usually operated from a transmission system having a fixed source of supply, and the power-factor of the motor is of great importance. A low-power-factor load requires a larger percentage of the generator and line capacity than does a high one. The best design for the commercial motor of high power factor usually requires a machine with as large a ratio of diameter to length as possible without undue sacrifice in cost and efficiency.

For marine work this standard of design can be greatly modified. First, the power demanded from the motors can be very accurately determined and, except for a slight variation due to depth of the propellers, roughness of the sea and steering, it is constant for any given speed. Second, the motors are supplied with external ventilation instead of being self-ventilated, and the amount of air forced through the motors for cooling can be varied with the load if so desired. These conditions taken together allow of a much smaller motor being used.

As the motors and generators are close together, the effect of the motor characteristics on the transmission system can be ignored and they can be designed directly for each other with special attention given to the combined characteristics of the units. To reduce further the size and weight of the equipment it is obvious that the comparatively low-speed motor end of the unit should be smaller in diameter and longer than is usual and the resulting lower power factor should be taken care of by increased size due to greater excitation necessary on the high-speed generator end.

The motor with a smaller ratio of diameter to length also gives greater efficiency due to the decrease in the fixed rotation losses and a greater percentage of active copper in the slots compared to the inactive copper in the end connections. Fig. 5 shows the small diameter and great length of those motors. The ratio of diameter to length in this case is two to one, whereas in the land type this ratio would be about four and one-half to one.

In addition to reducing the size by designing a lower-power-factor machine and using all the active material at both speeds, a minimum of weight with ample strength was obtained by the use of steel throughout for the mechanical structure. The stator frame was made up of a series of circular rings of I-beam section with dovetail ribs attached. Each ring is of sufficient strength to support its section of punchings and is held in position by being riveted to rigid steel feet. Boiler-plate extending the full length of the frame was rolled to fit the I-beams and was securely riveted to them, making a very rigid and compact structure. The problem of winding, insulating and supporting the stator coils was quite similar to that already discussed in connection with the generators.

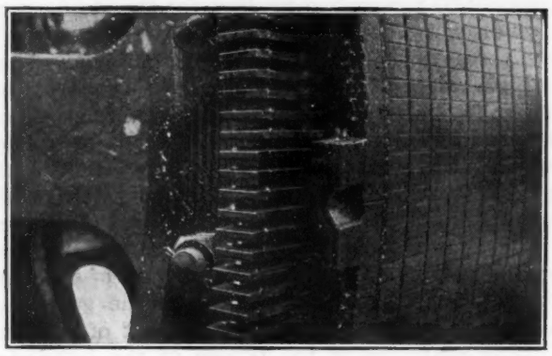


FIG. 4—A PORTION OF THE MOTOR ROTOR CONSTRUCTION, SHOWING EXPANSION JOINTS IN OUTER CAGE END-RING

PROVISION FOR EXPANSION OF END RINGS

The double squirrel-cage secondary winding (Fig. 4) consists of two entirely separate cages, the bars in both cases being driven into close-fitting slots without insulation, allowing the heat generated in these windings to flow freely by conduction into the rotor iron.

The outer cage is of high-resistance metal short-circuited by copper end rings into which the bars are brazed. This ring also is in intimate contact with the rotor punchings. Thus during reversal, when the greatest amount of heat is generated in this winding, the heat storage of the rotor iron is taken advantage of and the temperature of the bars kept down to a very conservative value.

The end ring is of special design made up of short sections connected together by expansion joints of laminated copper, thus allowing expansion due to heating being taken up between sections around the periphery and limiting the possible bending effect on the bars to a few mils instead of the comparatively large value which would exist if the ring were made solid and the diameter allowed to change. The inner cage is of copper. It was not necessary to break up this ring as the inner winding was designed to remain cool under all conditions of running load, the only condition under which the double squirrel-cage design allows full current in this winding.

The specified requirements for driving the New Mexico propellers called for 26,500 hp. at 161 r.p.m., corresponding to 21 knots ship speed, and 8350 hp. at 112 r.p.m. for cruising at 15 knots.

At speeds from 8 knots to 15 knots the four motors are operated on the thirty-six-pole connection from one generator with its winding connected in parellel, the switching being so arranged that either generator can be used. The variation of speed is obtained by steam control on the turbo-generator.

From 15 knots to 17 knots the motors are thrown over to the twenty-four-pole connection, still using one generator only. Above 17 knots two generators are used connected in two squares. The two motors and generator on the starboard side and the two motors and generator on the port side are connected together and each set is operated as a separate unit.

For reversing, the thirty-six-pole connection only is used. If the motor is running on the thirty-six-pole connection one phase is reversed. If operating on twenty-four poles, the connections are changed over to thirty-six poles and reversed.

The official trials on the driving equipment of the New Mexico were made Dec. 16-18, 1918. Runs were made at various speeds from 7.32 knots to 21.31 knots to establish points for the standardization curve. It dveloped that, owing principally to overloading, which

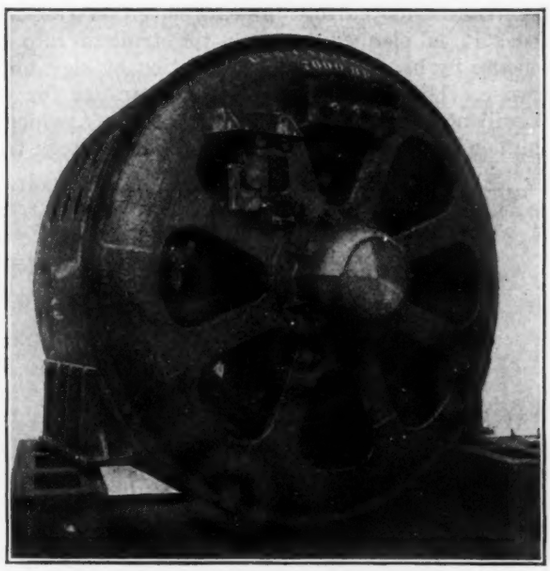


FIG. 5—VIEW OF ONE MOTOR ON THE CALIFOKNIA
The New Mexico motor is somewhat longer and has no contactor on the end shield

increased the displacement by more than 1000 tons, the power required to drive was 29,100 hp. at 161 r.p.m. instead of 26,500 hp. at a screw speed of 166.5 r.p.m.

Two runs over the course were very interesting. The two inboard propellers were run from one generator with the motors connected twenty-four poles and with the outboard motors disconnected, allowing the propellers to run free. Another trial was made with the outboard motors driving and the inboard propellers free. In both cases a little more than 15 knots speed was obtained. These two trials showed that to drive the boat at the same speed the inboard propellers required 11 per cent more power than was required by the outboard motors.

Naval experts and designing engineers were enthusiastic over the ease with which maximum load and reversing tests were accomplished by the New Mexico, and three new battleships of the same size, the California, West Virginia and Maryland, are being similarly equipped with electric drive.

Information concerning the generators and motors was given by C. S. Raymond and A. B. Badgley respectively, of the General Electric Company, where the electrical machinery was designed and built.

DISCLOSURES OF RADIO DEVELOPMENT IN WAR TIME

Simultaneous Reception and Transmission of Messages Made Possible and Interference from Other Radio Stations Neutralized

New radio developments in the use of sustained waves and spark transmitters which could not safely be made public during the war were described to the Institute of Radio Engineers, New York, on April 2 by Ernst F. W. Alexanderson of the General Electric Company. Among the salient points brought out in Mr. Alexanderson's paper were the following:

In order to send and receive radio-telegraphic or radio-telephonic messages simultaneously it was first necessary to neutralize the highly intensified transmitted signal so that the local receiving set could always be sensitive to the faint impulses of signals from the distant station. This was accomplished by the use of separate sending and receiving antennas and different wave lengths. The antennas were placed far enough apart so that the selectivity of ordinary receiving instruments could be depended upon for differentiation between the wave lengths of the sending and receiving stations.

This made it possible to give wire telephone subscribers the advantage of combined wire and wireless service. Each pair of sending and receiving stations were interconnected by a wire line and connected to an exchange of a wire telephone system. The telephone subscribers could then be connected to the radio system much as they would be connected to a toll line.

The system of radio-telephony just referred to is not suitable for communication between ships, trains and other places where the sending and receiving equipment should be a unit controlled by the same operator. In this case the two antennas were mounted on the same masts and inductive and capacitive neutralization were tried. The capacitive method was adopted because it was more accurate and simple. The nearby receiving and transmitting antennas were so arranged with their associated apparatus that the receiver and transmitter are in conjugate branches of a Wheatstone bridge. For this reason it is called the "bridge" receiver.

What is called a "barrage" receiver was developed to avoid interference from enemy and other radio stations, especially in transoceanic communications. This receiver is a combination of aperiodic antennas with unidirectional characteristics. With two antennas the phase difference of receiving currents depends on the direction of the incoming signals. Signals from any given direction can be balanced out by phase-shifting devices and a differential coupling to a common receiver.

In the discussion which followed Lester Israel, Lieutenant Lavender, George H. Clark, W. H. Priess, Lieutenant Arps, C. L. Farrand and E. Simon took part. Many of the speakers had successfully operated radio equipment such as Mr. Alexanderson described.

Electrical Service at Great Seaboard Terminal

Boston Army Supply Base, Costing $28,000,000, Is Equipped for Maximum Efficiency in Handling and Storing Either War or Peace Supplies—Electrical Agencies Include Elevators, Cranes and Industrial Tractors and Trailers

BROUGHT into being by the urgent demands of the war, but designed to furnish service at maximum efficiency even in time of peace, the Boston army supply base represents the last word in marine terminal development and stands to-day a monument of American engineering achievement under emergency conditions. Aside from the general interest which it commands, this terminal deserves attention because of its extensive use of electric power for operating elevators, cranes and industrial tractors and for lighting the vast expanse of working space. Great care was taken in laying out the distribution system to avoid interruptions in service and to enable the lines to be used flexibly. The vital importance of loading ships in the shortest possible time was constantly kept in mind by the designing engineers, who made arrangements for handling the peak load represented by a vessel at each berth loading for convoy service under war conditions.

The base occupies a site about 1.25 miles (2 km.) long, including rail approaches, and has a main working area about 4400 ft. (1350 m.) long and 400 ft. (120 m.) wide. A maximum of ten of the standard vessels of the Emergency Fleet Corporation can be accommodated at its berthing space.

The main storage buildings are arranged for section-

The terminal is equipped with the following freight-handling apparatus: forty industrial storage-battery electric tractors and 600 trailers; forty-six electric freight elevators with motor-operated hatchway doors; six automatic push-button passenger elevators; twenty-four electrically driven winches, and four semi-portal bridge cranes. The approximate cost of the present electrical equipment is $2,500,000, of which the wiring contract represents about $1,000,000.

A railroad yard with accommodations for 730 cars exclusive of ladder and running tracks has been built west of the base. After classification, cars may be taken to the proper section of the storehouse by three tracks on the northerly side of the property, to the pier shed by the same tracks or by two tracks on Terminal Street, to the wharf shed by the latter, and directly to the ship side by tracks on the wharves. Seventy-eight cars can be accommodated on the tracks alongside the storehouse platform. By using gang planks the trailers can be moved into the cars on either track and loaded. It is planned to push the trailers into the storehouse by hand for local distribution by elevator or otherwise. The distance traveled by a trailer for this work will not usually exceed 150 ft. (45 m.), which is the higher limit for hand operation. The battery trac-

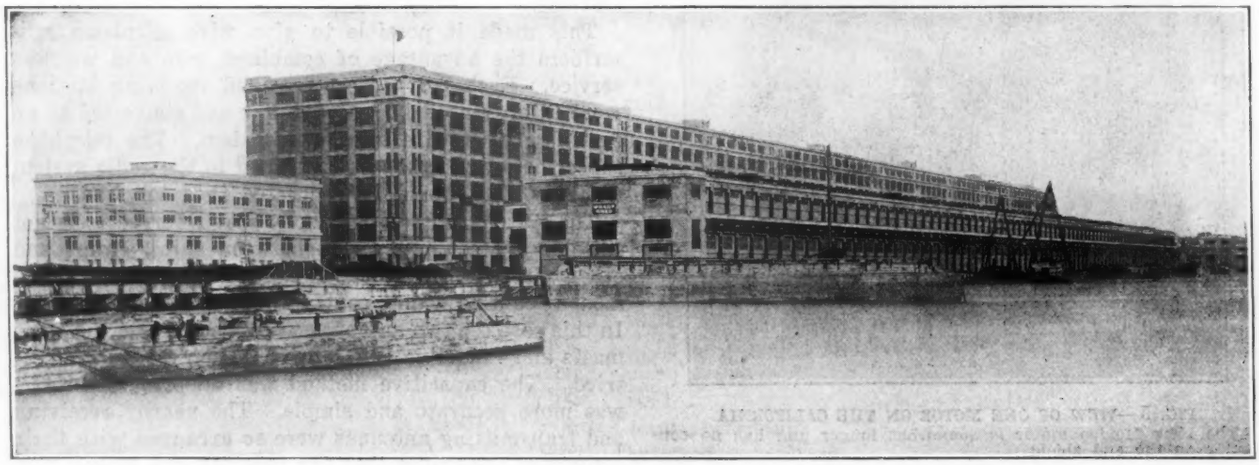


FIG. 1—IMMENSE STOREHOUSE AND WHARF FACILITIES OF ARMY SUPPLY BASE AT BOSTON

alized operation. The principal buildings include a main storehouse, wharf shed, pier sheds, substation, boiler house and administration building. The storehouse is one of the largest reinforced-concrete buildings in the world. It is eight stories high, measuring 115 ft. (35 m.) from first floor to roof, 1638 ft. (500 m.) long and 126 ft. (38 m.) wide, and is divided into six independent sections. Adjacent to it with connecting bridges over the intervening private street is a wharf shed 1638 ft. (500 m.) long, 100 ft. (30 m.) wide and two stories high, the second floor of the wharf shed being on the level of the third floor of the storehouse. The pier shed is composed of two three-story sections, each 924 ft. (280 m.) long by 100 ft. (30 m.) wide.

tors will probably be used chiefly in handling loaded trailers between the storehouse and wharf shed. The trailers are placed singly or in trains opposite vessel hatchways, to or from which the material will be handled by electric cranes on the wharf shed.

A tractor hauling four trailers will run about 4 miles (6.4 km.) per hour, and preliminary studies indicate that a round trip of a tractor, including the unloading of four trailers, can be made in about five minutes. It is estimated that 200 carloads, or 6000 tons of material, can be unloaded from the cars and placed in the storehouse in ten hours, or 4000 tons unloaded and placed in the pier shed; that 100 carloads or 3000 tons can be unloaded and stored on the first floor of the

wharf shed in ten hours, and that four wharf-shed cranes will load an 8000-ton vessel in about fifty-five and one-half hours. The tractors were supplied by the Baker R. & L. Company and the cranes by the Wellman-Seaver-Morgan company. All tractors have Edison batteries. Each section of the storehouse will be furnished with two Martin rotary-converter battery-charging sets and panels for tractor service.

The storehouse is equipped with twenty-four Otis electric freight elevators. Each has a capacity of 5 tons, at a lifting speed of 150 ft. (45 m.) per minute, and six A. B. See electric passenger elevators of the same speed and of 3000 lb. (1350 kg.) capacity each. The freight elevators have 17.5 ft. by 9-ft. 4-in. (5.2-m. by 2.8-m.) platforms and are each capable of carrying four loaded trailers on one trip. Entrances are provided at both ends. Each trailer has a capacity of from 1500 lb. to 2000 lb. (680 kg. to 900 kg.), and as each elevator can make twelve round trips per hour, there will be a total carrying capacity of at least 36 tons per elevator per hour.

All four elevators in each section of the storehouse will be operated from a dispatching station on the third floor. On each dispatcher's desk are operating buttons corresponding to each of the floors served by each elevator, enabling the dispatcher to send the elevator to any floor and also to call the elevator from any floor. Stop buttons are provided so that any car can be stopped in transit. Hatchway doors, however, cannot be operated from the dispatchers' desks but are opened automatically when the car reaches the landing.

Lamp-position indicators will show the dispatcher the position of each elevator, with pilot lights showing whether hatchway doors are open or closed. In order that the dispatcher may control the rapid handling of

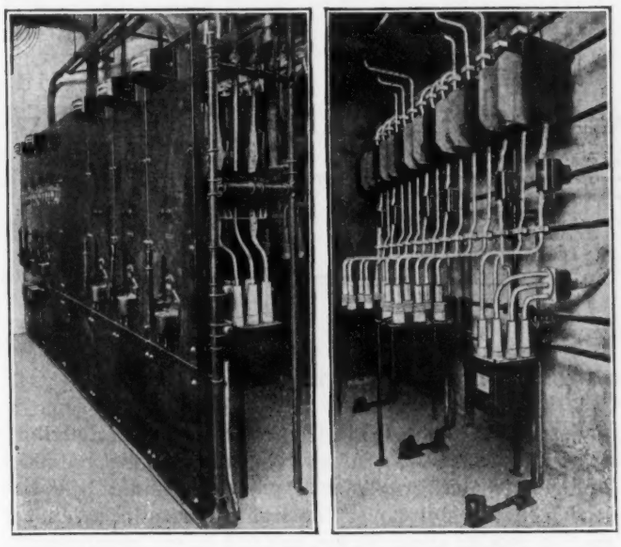


FIG 2—TYPICAL VIEWS SHOWING DISPOSITION OF APPARATUS IN SUBSTATION

freight at the various landings, a telephone system is provided consisting of an instrument on each side of the elevator well on each floor in each car and at the dispatcher's desk. A series of buttons permits the dispatcher to call and talk with any telephone.

Each elevator is equipped with a micro-leveling device, representing an important advance in design, which, after the car has made its initial stop, brings the car to within $\frac{1}{16}$ in. (1.5 mm.) of the floor level and maintains this level independent of the rope stretch during all conditions of loading and unloading. Micro-leveling is accomplished by an auxiliary motor on each machine to operate the elevator during the micro-leveling period.

The doors, which are electrically operated, begin to open as soon as the micro-leveling device comes into

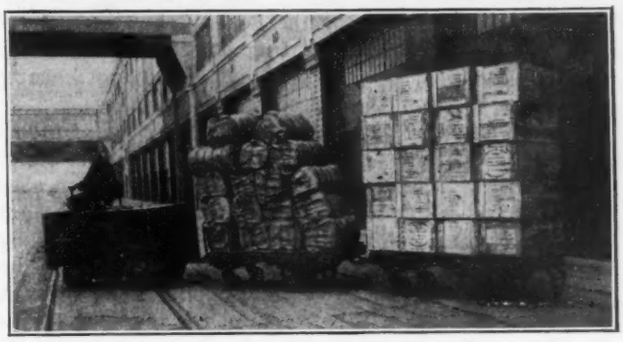


FIG. 3—ELECTRIC TRACTORS FOR TRANSFERRING LOADS FROM STOREHOUSE TO WHARF SHED

play, and by the time the car is level with the landing both doors (one at each end of the car) are opened. About five seconds are required to open the doors. The door-operating devices were manufactured by the Elevator Supplies Company. The equipment consists essentially of a motor-driven machine installed in a penthouse and arranged through a friction clutch to drive a chain connected to a series of sprockets in the elevator hatchway, one sprocket for each door. The doors on each side of the hatchway of any one elevator are operated by one overhead machine. The sprockets are carried on the same shaft as the counterweight sheave for the door and are connected to the sheave by an electric clutch. When the electrical system is out of order the door may be raised and lowered by hand.

An interlocking system is installed which normally will prevent the operation of an elevator unless all its hatchway doors are closed. In each car a switch inclosed in a glass case is provided, so that in case of fire or other emergency the interlock may be disconnected and the elevator operated irrespective of the position of the doors. A limit device is also provided which, through mechanical connection to the doors, opens the motor circuit when both doors are completely opened or closed. The elevator cars are equipped with car switches, and a double-throw switch is provided on the control panel in the car so that either the automatic system or the manual car-control system may be used. The car switches are mounted in a recess in the car inclosure, which also contains an annunciator, a telephone, emergency switches for car doors, a lighting switch and door-operating buttons.

The passenger elevators are provided with both push-button and car-switch control. An interlock is provided which engages with the car door when the car is opposite the landing, so that the opening of either door will open the other door also.

The pier sheds are each equipped with eight freight elevators of 6 tons capacity at 50 ft. (15 m.) per minute and having platforms 9 ft. 4 in. (2.8 m.) wide and 19 ft. 2 in (5.8 m.) long. The eight elevators in the south pier shed are of the Otis type and are similar to the storehouse elevators except that the cars are con-

trolled by buttons at the landings and not by a dispatcher. The eight elevators in the north shed are of the A. B. See type, being similar to the Otis machines but without the micro-leveling device. In the wharf shed are five electric elevators with a capacity of 6 tons at 50 ft. (15 m.) per minute, supplied by the F. S. Payne Company. These cars are controlled by car switch only. The doors for the elevators in the pier sheds and wharf shed are of the bi-parting, counterbalanced type, supplied by the Peelle Company, and are equipped with electric operating devices manufactured by the Elevator Supplies Company, embodying features similar to those of the storehouse doors.

All the elevator motors are of the three-phase induction type, operating at 220 volts. Those in the storehouse will be designed for two-speed operation, the higher speed being utilized after the elevator has got well under way. All elevator doors are operated by two-speed, three-phase induction motors of special design, furnished by the Elevator Supplies Company. A maximum of 2 hp. will be required for the door operation in any elevator well. The elevator control circuits will be energized by 220-volt. three-phase supply.

Energy for operating the electrical equipment is supplied by the Edison Electric Illuminating Company of Boston through two 13,800-volt underground cables, electrically operated, remote-controlled oil switches and will be protected at the generating station end by overload relays. Provision is made for a third incoming line in the future. Each incoming line is equipped with two oil switches enabling it to be thrown upon either a main or an auxiliary bus. Sectionalizing switches are provided in the buses so that the load upon any incoming line will be kept within predetermined limits and the possibility of interruption limited in case of any local ground or short circuit. Two sets of 2300-volt busbars are installed to insure continuous service and enable the distributing lines to be operated flexibly.

Each rotary converter is to be equipped with two remote-control carbon circuit breakers, and the outgoing direct-current feeders will be provided with type K breakers mounted on the low-tension switchboard panels. Either rotary is large enough to handle the entire direct-current load. The Condit Electrical Manufacturing Company furnished all the oil switches in the army base and about twenty switchboards of various sizes.

Each section of the storehouse is provided with a distributing switchboard. Three such boards are also installed in the wharf shed, two in each pier shed, and one each in the heating plant and administration building. Duplicate alternate-current feeders are run in

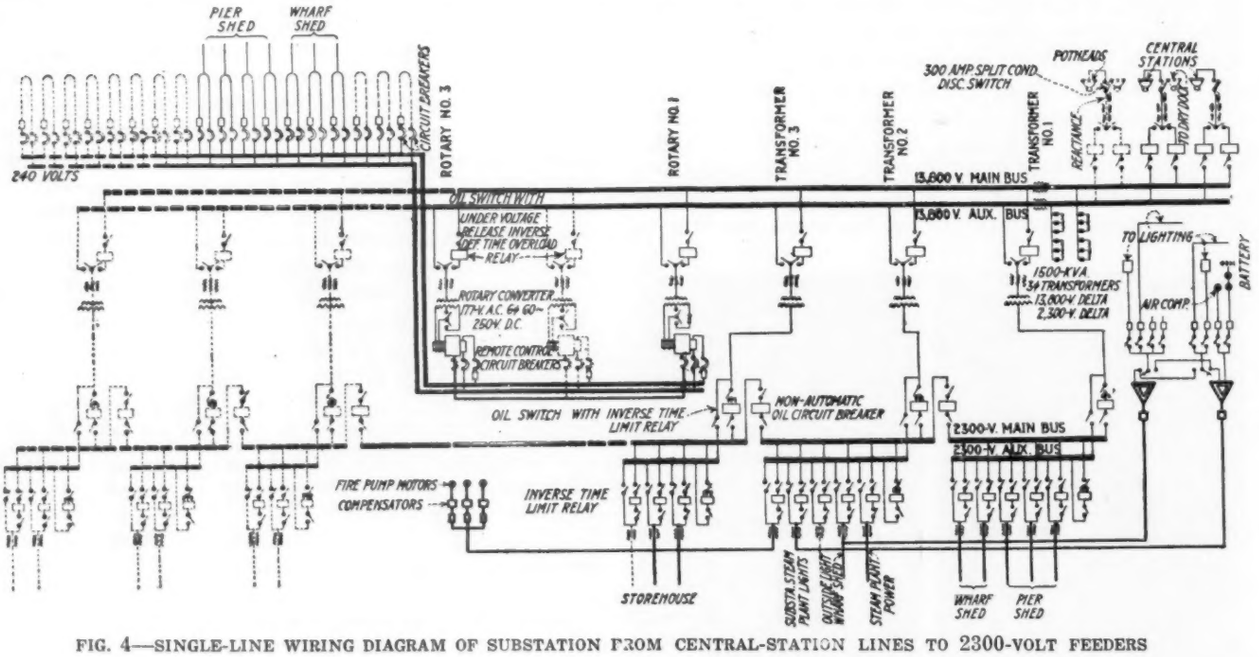


FIG. 4—SINGLE-LINE WIRING DIAGRAM OF SUBSTATION FROM CENTRAL-STATION LINES TO 2300-VOLT FEEDERS

either of which is capable of carrying the present load. In fact, the electrical system in general is duplicated between the source of supply and distributing panels to assure continuous service. At a substation on the army base site the high-voltage supply is stepped down to 2300 volts for distribution to transformers around the terminal, where the electricity is again transformed to 110 volts and 220 volts for power and lighting. Rotary converters provide 240-volt direct-current energy for hoisting and other service for which it is preferable. The substation is designed to handle an initial load of 4500 kva. and an ultimate load of 10,000 kva. The present installation includes three 1500-kva. oil-insulated, self-cooled General Electric transformers and two 500-kw. Westinghouse rotary converters.

The incoming 13,800-volt lines are equipped with F-6 underground ducts and in iron conduit to each distributing switchboard, with full switch protection, either feeder of any pair having sufficient capacity to handle the entire load. In the storehouse the lighting requirements per section totaled about 70 kw. and the power requirements 220 kw. during the war, but in industrial service these will be increased respectively to 300 kw. and 900 kw. To provide for quick changes and uniformity in equipment, there is one 300-kva. transformer for each storehouse section and one for each two sections of the pier sheds, each transformer having six terminals to deliver 220-volt and 110-volt three-phase service for power and lighting. If the load in the storehouse increases later and one lighting and three power transformers are required, the additional transformers of the present type can be added, and the three power transformers will be

operated in parallel on one set of low-tension buses. Six 300-kva. transformers have been installed in the storehouse, four equipments of this size in the pier sheds and one for a spare unit. Three 150-kw. transformers are provided for the wharf shed. All these transformers were furnished by the Pittsburgh Transformer Company. Smaller transformers are utilized for the boiler house, administration building, etc. As far as possible units employed during construction have been installed.

The permanent outside lighting is furnished by 500-watt and 1000-watt "Novalux" units mounted on poles and on the buildings, and also by 200-watt lamps in steel shades along the edge of the platform on the north side of the storehouse and along the water side of the wharf shed and pier sheds. To control these lamps special feeders are run from a separate panel in the substation; in addition, provision is made for feeding these lights in case of emergency from the local distribution centers. The interior of the storehouse is illuminated in general on the basis of one outlet for each 21-ft. by 21-ft. (6.4-m. by 6.4-m) bay, about 100 watts per outlet being allowed.

During construction a temporary substation was used with a maximum capacity of about 800 kva. This contained a pair of 200-hp. synchronous motors wound for 2300 volts, each motor driven by belting a pair of 60-kw. Edison bi-polar generators, delivering direct current at 120 volts. Each pair of generators was connected in series to provide direct-current 220-volt service. These units were loaned free by the Boston Edison company for the operation of direct-current hoisting motors during the construction period and as a source of direct-current energy for operating permanent equipment of this type in case the rotary converters planned for the final installation should be delayed in reaching the terminal. Energy for construction work was obtained from a 2300-volt underground feeder running direct to the terminal from the Edison generating plant. Local alternating distribution was effected by overhead 2300-volt lines feeding transformers on poles at various points on the site, whence 220-volt, three-phase power service and 110-120-volt lighting service was taken. Electric motors were extensively used in the construction work in the operation of hoists, concrete mixers, crushers, pumps, special machinery for supplying concrete to molds for the production of piles and other material essential in the building work.* The temporary substation was erected with a slate switchboard and oil-switch installation in less than thirty days from the beginning of construction, and during this period there were also erected 100 poles, 75,000 ft. (22,800 m.) of line wire, 1000 outlets for the interior wiring of temporary buildings, thirty motors and twenty transformers, all of which had to be purchased, delivered and installed in this short time.

The site was selected by Major-Gen. George W. Goethals, assistant chief of staff, in charge of storage and traffic, U. S. A., who also determined that the project should be of permanent character and that the main structure should be suitable for commercial use after the war. The storage capacity required and similar features were determined by Col. F. B. Wells, in charge of storage under General Goethals. Construction and disbursement of all funds were under the immediate supervision of Major Charles R. Gow, constructing quartermaster. Preliminary and final designs, field engineering and inspection were by Fay, Spofford & Thorndike, Boston, acting as supervising engineers for the War Department, with Hollis French & Allen Hubbard, Boston, acting as associate engineers for heating and power equipment. The general contractor was the W. F. Kearns Company, Boston, and the sub-contractor for electrical installation was Edwin C. Lewis, Inc., Boston. In general charge of the electrical design and construction for the supervising engineers was Roy R. Burnham, who was chief of electrical design and construction for the Victory destroyer plant at Squantum, Mass., and other important electical work in connection with the recent expansion of the Fore River Shipbuilding Corporation.

* The temporary outside lighting required about 125 1000-watt "Novalux' lamps, floodlamps and smaller incandescents also being used to some extent.

NEW HAMPSHIRE WATER POWER CONSERVATION

Report of State Commission Emphasizes Continued Importance of Fuel Saving, Use of Undeveloped Powers and Co-operative Conservation

Another valuable contribution to the cause of water-power conservation and development has been published in the form of a report of the New Hampshire commission on this subject. Reference has been made in these columns to the reports recently issued in Massachusetts and Maine, and the New Hampshire study adds data of much engineering importance to the information hitherto available in New England relative to stream power and storage facilities and possibilities. The New Hampshire report is signed by George B. Leighton, commissioner, and was prepared in coöperation with the United States Geological Survey, C. H. Pierce of Boston, Mass., being district engineer, with charge of the field work and technical side of the investigation.

The field work shows that there are in New Hampshire about 100 places where storage reservoirs may be constructed at a greater or less expense. Each case, however, needs special study. It was hoped that it might be possible to find within the state a location where a large storage reservoir of several square miles area could be established, but such a place has not been found. There are places where an outlay of $100,000 or more will be justified, particularly at Keene, and again there is the project of increasing the storage capacity of Lake Winnepesaukee, but the majority of storage sites discussed are of moderate capacity, though in the aggregate they will hold a great deal of flood water.

Careful consideration should be given to undeveloped powers, the report states. On the Connecticut there are three important water-power sites from which it is estimated that 345,000,000 hp.-hr. can be secured yearly, and on the Merrimack and its tributaries it is estimated that there are nine undeveloped powers with a total annual output of 145,000,000 hp.-hr. The importance of coöperative conservation is touched upon, and the work of the Androscoggin Reservoir Company in Maine and that of the Wisconsion Valley Improvement Company are commended. It is hoped that the present Legislature will outline a policy of water-power conservation through use and development. It appears that the amount of power at the present power developments which would be saved by fairly complete systems

of storage would be the equivalent of about 173,000 tons per year in New Hampshire and of about 105,000 tons per year outside the state, a total of 278,000 tons per year, not including the Androscoggin River. At the low coal price of $4 per ton this represents a saving to the people of more than $1,000,000 per year.

The commissioner does not feel that a mutual organization to develop storage facilities would be feasible in New Hampshire except to a limited extent on the headwaters of the Connecticut and Androscoggin Rivers, because only where a few large users of power are found on a stream, as in Maine, is such an organization satisfactory. The storage construction, he believes, should be done either directly or indirectly by the state, through the Public Service Commission. It is recommended that the Public Service Commission be empowered to investigate and prepare a report on each project, whether large or small, ascertaining the probable costs of construction and operation and the probable revenue. The revenue can be saved by entering into long-time contracts with power users on the basis of coal saved and the value of new power developed.

In conference with power companies it is gratifying to learn that they are willing to pay liberally for water power as a substitute for coal. If, for example, it is found that 10,000 tons of coal can be saved in a certain river basin if the flow is more equal, the mills should be willing to pay at least $30,000 per year, or 10 per cent on a cost of $300,000. Each project should be at least self-sustaining, the report maintains. In normal times the state can secure money at less than 5 per cent and the cost of operation may be below 2.5 per cent, so that the total cost may be nearer 8 per cent than 10 per cent.

The estimates in the report are based on 50 per cent increase in pre-war construction costs, plus land damages, flowage rights, etc., at present estimated values. It was assumed that the load factor of each power plant was high enough, so that, taken in connection with the pondage available, no stored water released from the reservoirs during the season when storage was needed would be wasted. It was also assumed that reservoirs would be filled to capacity and completely drawn once each year. Power-plant efficiency was assumed to be 80 per cent and a coal consumption averaging 3 lb. per kilowatt-hour was adopted as more representative of New Hampshire steam-plant operations than the 2-lb. rate often taken.

Modern Bus and Switch Structures

Increase in Size of Generating Units and of the Number Operated in Parallel Has Necessitated Accommodation of New Types of Circuit Breakers and Reliable Support of Buses —Details of Methods of Installation

BY C. D. GRAY AND M. M. SAMUELS
J. G. White Engineering Corporation

DESIGNING of masonry bus structures has become a distinct and prominent branch of power-plant electrical engineering. Although they have undergone a great many changes and improvements since their inception, and particularly within recent years, they have not yet reached any final form and still give the designer and construction man a great deal to consider.

Gradual development, rather than radical changes or inventions, brought about the modern type of bus structure. Engineers realize more and more that safety and continuity of operation of a station depend to a great extent upon the reliability of the bus structure (which may be called the spine of the station) and are willing to devote more time to its design and careful construction. Furthermore, persons financing the building of power plants have also come to realize that a little additional expenditure on a bus structure will prove ultimately to be a good investment.

DEVELOPMENT OF NEW TYPES OF BUS STRUCTURE

Since last writing on this subject* new ideas have had to be injected into the design of bus structures, and entirely new types of structures have been developed. This was due primarily to the increase in the number of large turbo-generator units installed in single stations and the concentration thereby of large quantities of energy, which necessitated the development of new types of circuit breakers (capable of rupturing enormous short-circuit currents) and the adaptability of the bus structure to such circuit breakers. Whereas only a short time ago a 15,000-kw. turbine was the largest made and offered very little difficulty in switching, 70,000-kw. units are now being installed and have to be taken care of by suitable reliable switching.

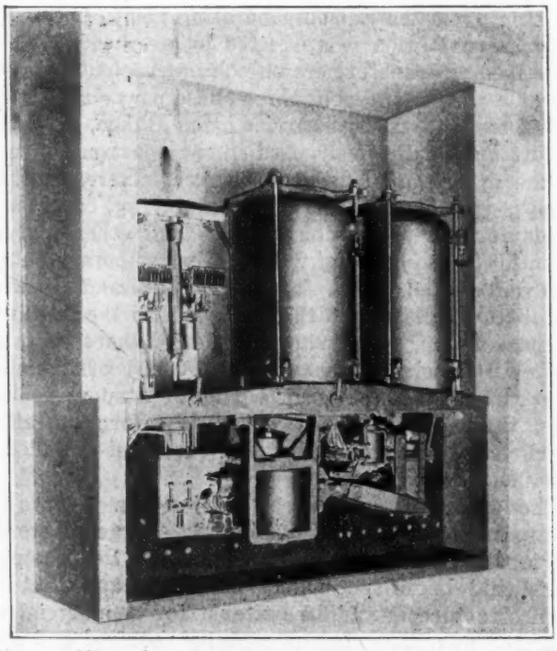


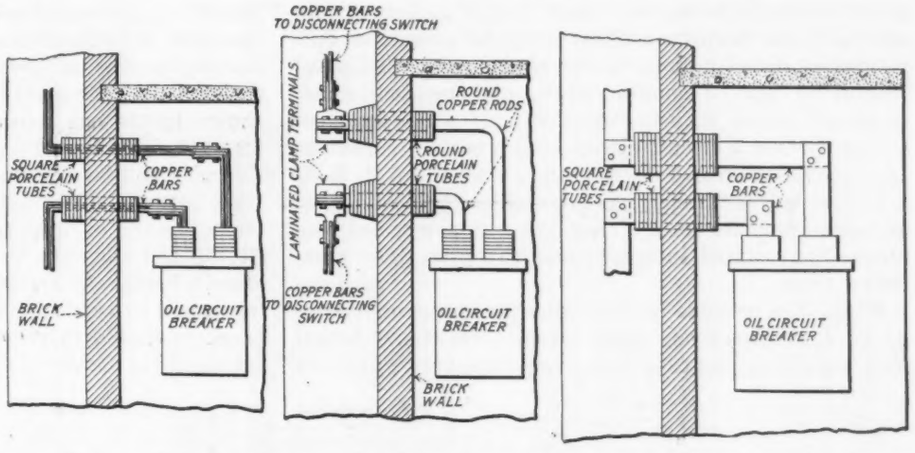
FIG. 1—OIL CIRCUIT BREAKERS RATED AT 2000 AMP., 15,000 VOLTS WITH RUPTURING CAPACITY OF 650,000 KVA.

*See ELECTRICAL WORLD, Jan. 15, 1916.

In addition to these difficult switching problems the bus structure designer has to face many demands made upon him by liability insurance companies, which continually and justly require that new safety features be introduced for the protection of life and property.

It is therefore the object of this article to show how some of these problems are being solved and to give a description of some of the most modern types of bus structures and also a brief review of new types of apparatus now being used in modern bus structures.

Determining Required Space.—It often happens that the floor space and height of gallery for accommodating a switch and bus structure are determined on the preliminary assumption of a certain circuit breaker and a certain arrangement of feeders before an actual decision is made on the switching. If the building is then finally designed on the basis of these preliminary assumptions, a great deal of juggling and changing becomes necessary if finally a different type of circuit breaker or a different arrangement of circuits is decided upon, and the result is always a poor switching layout, often unnecessarily complicated.



FIGS. 3, 4 AND 5—ARRANGEMENTS OF SWITCH TERMINALS THAT FACILITATE CONNECTIONS WITH DISCONNECTING SWITCHES, FUSES, CURRENT TRANSFORMERS, ETC.

It must be remembered that different oil circuit breakers require not only different spacings of floor beams but also different heights and widths of galleries, and that whereas some circuit breakers give a good layout with the bus and circuit breaker on the same floor, others will give a much better arrangement if the apparatus is arranged on two or even three galleries. It is therefore a good policy not to make up a final design of the building part accommodating switch and bus structures until the types of all circuit breakers and the arrangement of circuits are finally determined upon. Since the electrical switching is generally housed in a building lean-to, outside of the crane columns, it will be found that the delay caused in the design of this lean-to, which might be caused by the making of a good switching layout, will not hold up the design of the rest of the building, and the inconvenience which may be caused by it will be amply repaid by a good and well-balanced and proportioned layout of the switching arrangement. It would surely cause no delay in the erection, since the difference would only be a matter of a week or two, and sometimes only a day or two. It should never be left out of sight that the building should be designed to suit the apparatus instead of trying to accommodate apparatus to a predetermined building.

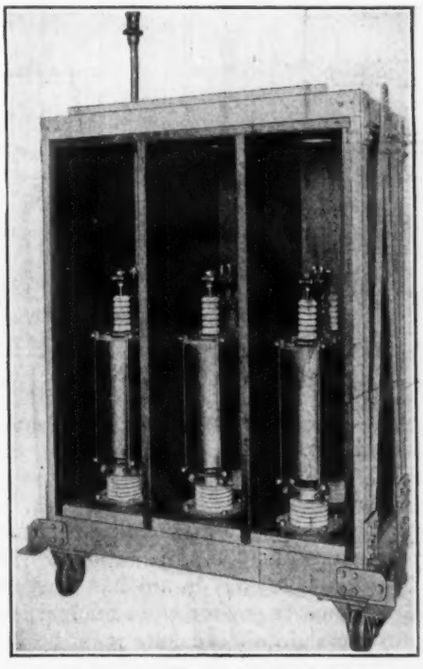


FIG. 2—OIL CIRCUIT BREAKER RATED AT 800 AMP. AND 15,000 VOLTS AND CAPABLE OF RUPTURING 600,000 KVA.

Oil Circuit Breakers.—A great deal of discussion has been taking place recently in various engineering societies as well as in current literature with reference to the rupturing capacities of circuit breakers. The thorough study which manufacturers have made of the subject, as well as the great amount of laboratory research in connection therewith, have developed new types of oil circuit breakers which promise to be a great help in the further combination and concentration of energy that is bound to come in the period of reconstruction and readjustment. Circuit breakers are now made which are guaranteed to rupture the very high short-circuit currents which may occur on modern interconnected systems. For example, the J. G. White Engineering Corporation is now installing a number of 12,000-volt, 2000-amp. circuit breakers, like the one shown in Fig. 1, which are guaranteed to have a rupturing capacity of 625,000 arc kva. and are capable of opening such a short circuit twice in succession at least one-half minute apart and still be immediately reoperative without its being necessary to inspect or clean the contact parts or renew the oil. Furthermore, it is possible to perform this operation without throwing an excessive quantity of oil or damaging any part of the breaker beyond the burning or pitting of arcing contacts. Such breakers must of course be so designed mechanically as to withstand the mechanical stresses that may be imposed upon them during the first few cycles of the short

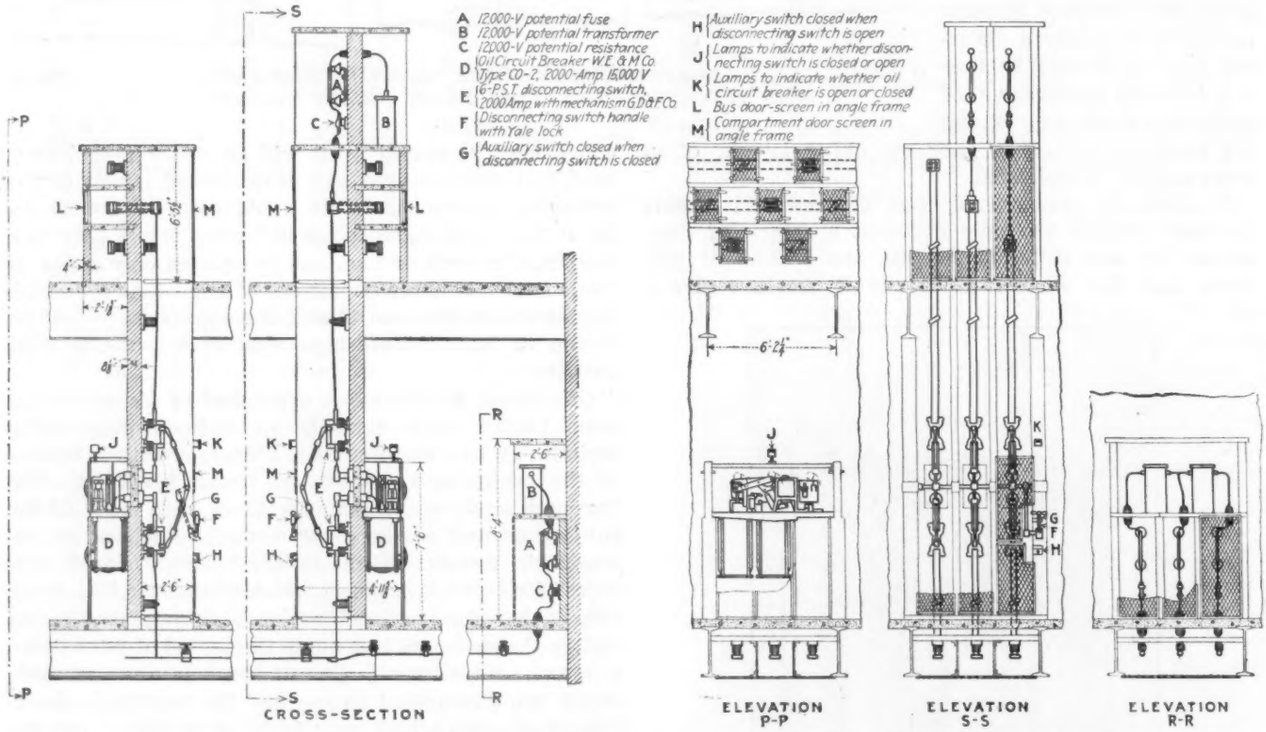
circuit when unsymmetrical currents of high value may exist. The calculated instantaneous short circuit for this particular installation is 580,000 kva. at 12,000-volt operation, so that if the circuit breakers come up to their guarantee there should be no difficulty in taking care of any short circuit which may occur.

There are still a great many misunderstandings with reference to the definition of "rupturing capacity." Until a better definition is developed the proposed definition of the A. I. E. E. should be insisted on, which reads: "By interrupting (breaking or rupturing) capacity is meant the highest r.m.s. current at normal voltage which the device can interrupt under prescribed conditions at stated intervals a specified number of times." Rupturing capacity should therefore be specified in "arc amperes" rather than in "arc kva." It is not sufficient to specify that a circuit breaker has a certain rupturing capacity based on A. I. E. E. rating, since the A. I. E. E. definition leaves three things open which must be defined in each individual case: They are (1) prescribed conditions, (2) stated intervals, and (3) prescribed number of times.

While it is possible to determine the rupturing capacity of a comparatively small circuit breaker by actual tests, this is not the case with circuit breakers which are intended to rupture very heavy short circuits, since a public utility company having such a vast amount of energy available will not permit a short circuit of 1,000,000 kva. or more to be established on its system for the purpose of determining the rupturing capacity of a circuit breaker. For circuit breakers of such enormous capacities the given rupturing capacities are of necessity based on certain assumptions and intelligent guesses. When giving rupturing capacities of large circuit breakers that cannot be actually tested, the assumptions should therefore be specified which were used as a basis for determining the rupturing capacity.

In addition to the rupturing capacity, the mechanical and electrical details of a circuit breaker should be carefully looked into in each case before definitely deciding upon the use of a certain type. The construction of the contacts, the breaking distances, the sizes of the oil vessels, the details of the operating mechanism and other important details of various types of proposed circuit breakers should be compared and well investigated.

In a majority of cases, when oil circuit breakers are used in bus structures, one side of the breaker will be connected to the bus while the other side will be connected to a generator or feeder. In such cases, therefore, the most suitable arrangement of terminals for the oil circuit breaker is obviously to bring these terminals through the rear masonry wall, one above the other, as shown in the bus structures illustrated in this article. The terminals should be arranged in such a way that no difficulty will be experienced in working out the connection bars to disconnecting switches, buses, current transformers or cables. The arrangements shown in Figs. 3 and 4 are the best suited to the purpose in most cases, whereas the arrangement shown in Fig. 5 will only be desired on very special occasions. Standard oil circuit breakers should therefore be designed for the terminal arrangement shown in either Fig. 3 or Fig. 4. In order to avoid the excessive heating of contacts, laminated terminals for bar connections should be insisted on for all circuit breakers of 1000 amp. or over. The recent tendency in circuit-breaker design has been rather too much toward compactness, for the principal reason that a great many such circuit breakers must be installed in existing buildings where only a limited amount of space is available. While compactness has a great many advantages, the question of accessibility should not be lost sight of, and in new power plants of large capacities more liberal spaces should be allowed for switching than has heretofore been the custom.

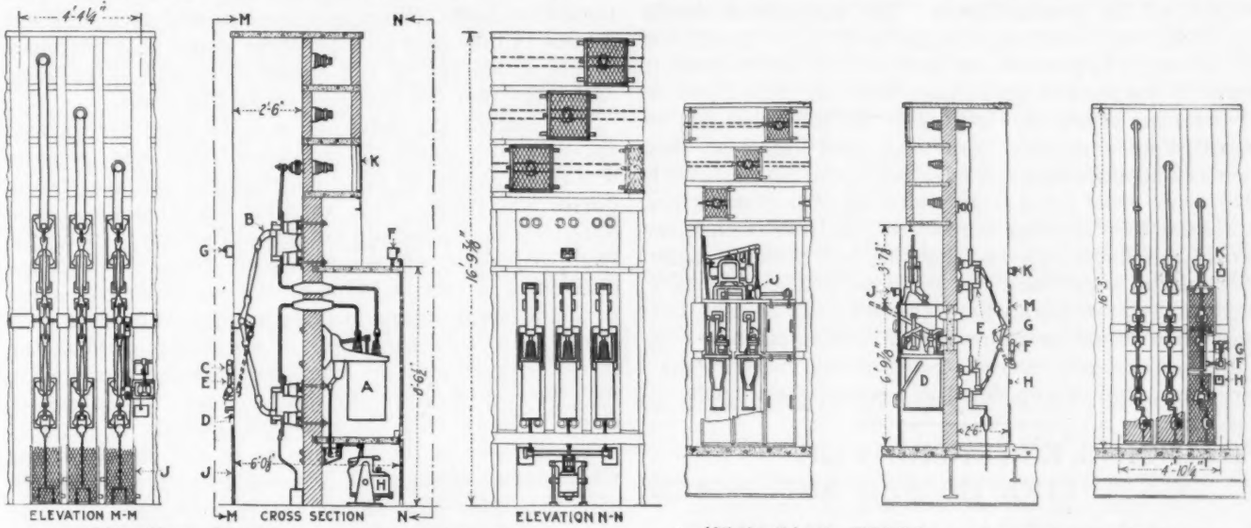

A 12,000-V potential fuse
B 12,000-V potential transformer
C 12,000-V potential resistance
D Oil Circuit Breaker W.E. & M.Co. Type CO-2, 2000-Amp. 15,000 V
E 6-P.S.T. disconnecting switch, 2000 Amp with mechanism G.D.&F.Co.
F Disconnecting switch handle with Yale lock
G Auxiliary switch closed when disconnecting switch is closed
H Auxiliary switch closed when disconnecting switch is open
J Lamps to indicate whether disconnecting switch is closed or open
K Lamps to indicate whether oil circuit breaker is open or closed
L Bus door-screen in angle frame
M Compartment door screen in angle frame
CROSS-SECTION
ELEVATION P-P
ELEVATION S-S
ELEVATION R-R

FIGS. 6 AND 7—LATEST TYPES OF MASONRY BUS STRUCTURE FOR A 12,000-VOLT, 1,000,000-KVA. INSTALLATION HAVING ALL IMPROVEMENTS MENTIONED IN ARTICLE

With the increase in sizes of circuit breakers and their mechanisms, the problem of handling, installing and adjusting them is becoming more difficult. Being usually shipped disassembled, it is very difficult to handle the heavy parts of circuit breakers in the switching gallery without the aid of a crane. Therefore the tendency in the design of new circuit breakers should be to develop portable steel frames which will accommodate both the circuit breakers and the operating mechanism and which will also take care of all mechanical stresses. If this is done, the circuit breaker and mechanism can be assembled and adjusted at the factory by experienced men who are very familiar with every part of the apparatus and who would be able to find and remedy misfits or other troubles more quickly than would a construction man in the field, whose experience must be more varied and therefore less specialized. Such an arrangement has just been developed recently and is shown in Fig. 2. It can be shipped assembled and be set in place without any difficulty. The set shown is a triple-pole breaker for 15,000-volt, 500-amp. service and has a rupturing capacity of 18,000 arc amp., or approximately 460,000 arc kva. Removable barriers of asbestos wood are provided between phases instead of the usual brick walls. While masonry division walls are not required between adjacent sets of these structures, such walls can be built much more easily than the usual cells when desired, because the barriers between switch pots and provisions for mounting the switch and mechanism do not have to be made. In an installation containing several such circuit breakers one or two can be kept as reserve and used to replace defective circuit breakers when this is necessary.

Disconnecting Switches.—Even though the disconnecting switch is only an auxiliary to the oil circuit breaker in a majority of cases, serving the purpose of disconnecting an oil circuit breaker from energized parts when it is necessary to inspect or repair it, it is nevertheless a very important part of a bus structure. In the past nearly all disconnecting switches were operated by means of switch hooks. This method of operation is gradually being abandoned for various reasons which have been discussed in detail in the ELECTRICAL WORLD on previous occasions. The modern method is to install a mechanism for operating the three or six disconnecting switches of one circuit by one common handle. Thus the possibility of an operator opening a disconnecting switch accidentally by means of a metallic rod when a switch hook happens to be mislaid is entirely eliminated and a circuit breaker can be cleared very quickly for inspection or repair by one operation of the disconnecting switch handle. This also prevents the opening or closing of one phase of a circuit without performing the same operation on the others. It also obviates the chance of opening two phases of one circuit and one phase of another under stress of excitement. The door of the disconnecting switch compartment can remain closed permanently and need only be disturbed when it is necessary to repair a disconnecting switch, which is not a very frequent occurrence. A Yale or similar lock can be installed on the handle, thus making it impossible for the switch to be opened or closed by an employee who is not authorized to do so. Auxiliary switches can be attached to the handle or other parts of the mechanism for the purpose of operating indicating lamps at the oil circuit breaker, so that an operator inspecting or repairing the apparatus will know definitely that the respective disconnecting switches are open. These auxiliary switches can also be used for operating indicating lamps at transformers, buses or other parts of a circuit remote from the switching to indicate definitely whether or not the apparatus or circuit is energized.

The switches shown in Figs. 6, 7, 8 and 9 are about the latest types of mechanically operated disconnecting switches for compartment use. The insulating members of the mechanism consist of wooden rods, the auxiliary switches are operated directly by the handle, the lock is inserted in the handle, and the various parts of the mechanism are held in the masonry by means of cast-iron inserts, making the arrangement rather com-


ELEVATION M-M
CROSS SECTION
ELEVATION N-N
A Oil Circuit breaker G.E. Co. K-12 800 Amp. 15,000 V.
B Disconnecting switch G.D. & F. Co. 6-P.S.T. 600 Amp. 15,000 V.
C Auxiliary switch closed when disconnecting switch is closed
D Auxiliary switch closed when disconnecting switch is open
E Disconnecting switch handle with Yale lock
F Signal lamp to show if disconnecting switch is closed
G Signal lamp to show if oil circuit breaker is closed
H Solenoid mechanism
J Screen door
K Bus door, screen in angle frame
D Oil circuit breaker W.E. & M. Co. Type E-6, 600 Amp. 12 V
E 6-P.S.T. switch, 600 Amp. with Mechanism G.D. & F. Co.
F Disconnecting switch handle with Yale lock
G Auxiliary switch closed when disconnecting switch is closed
H Auxiliary switch closed when disconnecting switch is open
J Lamps to indicate whether disconnecting switch is closed or open
K Lamps to indicate whether oil circuit breaker is closed or open
L Bus door screen in angle frame
M Compartment door screen in angle frame

FIGS. 8 AND 9—MODERN 12,000-VOLT BUS STRUCTURE FOR STATIONS RATED AT LESS THAN 1,000,000 KV.

plicated. It requires a very deep compartment, and since the compartment is very narrow, the width being limited by the dimensions of the oil circuit breaker on the opposite side of the wall, it is difficult to install and adjust the disconnecting switches and parts of the mechanism within the compartments. This type of disconnecting switch, even though it offers a great many advantages over the old types, cannot be considered as final.

New types of switches will have to be developed to meet all the requirements of a modern masonry switch structure. A satisfactory disconnecting switch should be very simple, should have very few parts, should not require a very deep compartment, and should have all parts of the mechanism which are not insulated on the outside of the compartments. The mechanism should not in any way interfere with the door, and it should not be necessary to provide any slots in the door to permit parts of the mechanism to pass through. The three or six switches of one unit with their mechanism should be mounted on a common structural steel frame so that they can be assembled and adjusted at the factory. With the heavy short circuits to which modern systems are subjected, the disconnecting switches or their mechanism should be reliably locked so that they will not open under short-circuit conditions. For small circuits of secondary importance hook-operated switches may still be used, but even these should be equipped with locking catches.

Busbar supports, current transformers, masonry material, etc., will be considered in a second installment.

FINANCING EXTENSIONS OF LINE IN WAR AND PEACE

Report of Committee Appointed at 1918 War Convention of N. E. L. A. Deals with Many Possible Conditions

AT THE 1918 war convention of the National Electric Light Association a special committee was appointed to report on the subject of financing extensions of line under war conditions. Its members are E. W. Lloyd, chairman; H. C. Abell, M. R. Bump, Alex Dow and R. S. Hale. Its conclusions were ready about the time the armistice was signed. The report was therefore revised. The committee recognizes that its applicability under peace conditions is obviously "limited to the exceptional cases where the company's custom or policy, or the standing rule of the public utility having authority, does not provide for the making of extensions in the ordinary way and as part of the ordinary investment of the company."

Following are extracts from the report:

When it is decided that an extension is to be made, any portion of cost which cannot properly be capitalized and spread over the rest of the business should be borne directly by the customers for whom the extension is made. The portion to be capitalized may at the option of the company: (1) be borne by the company without further action by the customer; (2) the company may ask the customer to guarantee an income for a term of years, or (3) the company may require that the customer, in addition to paying outright the abnormal portion of the cost, shall deposit an amount equal to the normal portion, on the understanding that each year some portion of the income shall be used first to pay interest on such deposit or on any unreturned balance, and next in order to return the deposit until all of the deposit is returned, provided also that if at the end of some reasonable term of years the deposit is not all returned the transaction shall nevertheless terminate and the unreturned balance be forfeited to the company.

Ordinarily a line extension is merely the healthy growth of a company, since an extension brings in enough income to pay all of the first two following items and usually enough more to pay the third: First, the added expenses (that is, added operating expenses) involved by the new business; second, enough more to pay the fixed charges on the extension; third, the additional income which gives a greater return or profit than would have been obtained if the extension had not been made. This extra profit can then be used for the benefit either of the stockholders or of the earlier customers, or both. When an extension will give sufficient income to take care of these three items, it is obviously to the advantage of the stockholders and of previous customers that the extension should be made.

The cost of the extension may be high for various reasons. The reason that has been troublesome recently was the high cost of labor and material and also money during war times. This war-time condition was only a difference in degree and not any difference in principle from conditions that occur in peace times. Shall these differences in cost be borne by the particular customers in the different streets, making a different price in each street for the future supply of electricity, or shall the costs be spread over the whole business and averaged so that the cost of electricity shall not vary from street to street but only with the kind and quantity of service?

The answer is pretty clear as to the principle that when abnormal costs are incurred solely for the benefit of a particular customer or set of customers, the rest of the customers should not always be called on to pay the abnormal costs. However, the problem of deciding what is the normal cost and what is abnormal is not so easy. The public cannot be called on to decide the detailed figures for each case, but the public in America has very generally appointed commissions which issue rules and regulations of service and frequently decide what expenditures for special extensions should be made, what balance should be paid for by the public utility, and which portion the company may capitalize. When an expenditure is capitalized, then it is spread over the whole business. If, on the other hand, the commission will not allow it to be capitalized, then it obviously should be borne by the customers benefited.

The committee also takes up the question of abnormally low income as one that may cause equal injury to the other customers. The income may be so low that it does not provide for operating expenses and return on the new investment, and then in the long run the rest of the business will have to make up the difference if the customers on the new extension do not either provided enough extra income or a part of the cost.

In order to protect the company properly, the most practical scheme is for the customer to deposit with the company the cost of the extension, or rather the normal portion of the costs. The abnormal portion of the cost should be paid by the customer outright without hope of return. If the income proves too low, the customer never gets his money back and may not get even full interest. This is not unfair, since in these cases the extension, even if it has cost the company no capital expense beyond the deposit, may have increased the company's operating expense for patrolling, etc., and in any case has given no profit to the company.

STATION & OPERATING PRACTICE

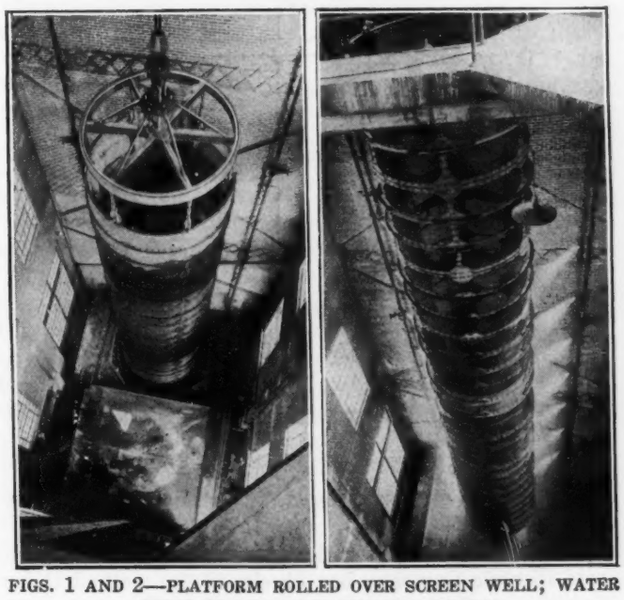
A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

WATER INTAKE SCREENS ARE EASILY AND QUICKLY CLEANED

Leaves Must Be Removed as Often as Once an Hour at Times, but Screens Are So Effective that Condensers Keep Clean for Three Weeks

Each fall the Ohio River, which drains a watershed on which there are a great many forests, is filled with an enormous amount of leaves. As condensing water for the Louisville (Ky.) Gas & Electric Company is taken from this river, some means had to be devised to strain the water to avoid cleaning the condenser too frequently. Furthermore, provision had to be made to clean the screens, for otherwise the intake would be completely closed because of the severe conditions imposed.

This problem has been successfully solved by the use of three concentric cylindrical screens 60 ft. (18 m.) high, any one of which may be hoisted independently of the others. During the worst period these screens are hoisted each hour and cleaned by water jets striking the screen tangentially and causing it to revolve. A platform rolled under the screen covers the screen well and catches the leaves and water as they are washed off. This refuse drops through a grating and flows out to the river together with the discharge water from the condensers.



FIGS. 1 AND 2—PLATFORM ROLLED OVER SCREEN WELL; WATER SPRAY ROTATES AND CLEANS SCREEN

During the year these screens have been in use they have strained as much as 75,000 gal. (28,000 l.) of water per minute. At low water they are immersed for a depth of 20 ft. (6 m.), but they are fully immersed at times when the river is at its height. When the river is low and clean the screens are not cleaned more than once in three weeks, but during times when the river is full of leaves the screens are cleaned as often as once every hour. This operation can be accomplished in twelve minutes. These screens are very effective, for even when the river is turbid the condensers are cleaned only once every three weeks.

On account of the cylindrical shape of the screens no difficulty is encountered in raising them like that present with flat screens when the difference in pressure on two sides is great. The inside screen measures 8 ft. 8 in. (2.6 m.) in diameter, the middle one 11 ft. 4 in. (3.4 m.) and the outer one 14 ft. (4.3 m.).

The screen house and intake tunnels were designed and erected by H. M. Byllesby & Company, Chicago, but the arrangement of screens is covered in a patent owned by Donald McDonald, vice-president and general manager of the Louisville (Ky.) Gas & Electric Company.

INFLUENCE OF HIGH ASH ON BOILER CAPACITY

Capacity Reduced Because Sufficient Coal Cannot Be Burned on the Grates to Do the Necessary Work When High Ash Is Present

The increase in the ash content of coal seriously reduces the capacity of steam boilers because the excessive quantity of coal required to deliver a horsepower with poor coal makes it impossible to consume sufficient coal on the grate to deliver the necessary boiler horsepower. Central stations find that, whereas their boiler houses two or three years ago were of sufficient size to handle all ordinary increase in power demands, now, because of the poorer quality of coal, it is difficult to provide the steam necessary to carry the station load. Until two years past it was considered good practice to operate central-station boilers at 200 per cent to 250 per cent of their rated capacity during peak periods. In the same stations it is now difficult to operate the boilers at more than 150 per cent to 160 per cent of their rating, and sometimes even at that. It is therefore necessary for these stations to place more boilers on the line, and in many cases they have been compelled to purchase more boiler units at unusually high prices.

The effect upon industrial plants is similar to that experienced by the central stations but in a different degree. Industrial plants do not usually operate their boilers at the high ratings experienced in central-station practice, but neither do they as a rule carry so large a percentage of spare boiler equipment. Therefore they find it necessary to operate their entire boiler equipment or curtail production, and their boilers are kept in service for longer periods than is good practice. It is impossible to take the boilers out of service long enough to free them properly from scale and to repair baffles and brickwork in the furnaces properly. The consequence is that the boiler efficiency is seriously re-

duced until they are in such poor condition that they must be shut down for cleaning at the expense of production. With reasonably clean coal this situation would not exist. Another solution is modification of the grate to handle the lower-grade fuel.

This information was taken from a report of the engineering committee of the National Research Council of the National Coal Association prepared by the J. G. White Engineering Corporation of New York.

TELEPHONE LINES EQUIPPED TO OVERCOME INTERFERENCE

Power Company Eliminates Disturbing Effect of Its 60,000-Volt Power Line by Using Shield Between Transformer Windings

After several years' experience the Seattle municipal lighting department has developed a satisfactory means of protecting telephones from inductive interference on the city's 40-mile transmission line. The telephone wires are strung 15 ft. (4.5 m.) below the power wires, which consist of a 60,000-volt star-connected circuit with grounded neutral. Transpositions had been put in the power line, but conditions occasionally arose under which considerable interference occurred. Effort has therefore been made so to arrange the telephone circuits that interference will be eliminated under normal operation and protection afforded for such unbalanced conditions on the power circuit as may arise.

The plan which has succeeded after the failure of several other attempts has been to install on all telephone services a special closed-core transformer of a design worked out by J. D. Ross, superintendent of lighting, and built in the city's shops. In this transformer a heavy brass sheath separates primary and secondary coils. The edges of the sheath are overlapped but insulated to prevent its becoming a secondary of one turn. The sheath is grounded, as is also the secondary of the transformer. This design is the same as that used on small power transformers which step down from 60,000 volts to 125 volts and 250 volts for the accommodation of patrolmen along the right-of-way.

The idea for this transformer developed when it was found that an operator could get a heavy shock through the transformer acting as a condenser even if it did not puncture. To prevent this the sheath was added and made of a considerable thickness. With this arrangement no static impulse can pass to the telephone, and the operator is protected in case a high-tension conductor should break and fall over the telephone line. No insulated stool is used for high-tension telephone operators.

It was found difficult to design a transformer that could be used for both ringing and talking, particularly when the induction from power lines is severe. Based on the principle that the greater the ratio of talking current to induced current, the better the conditions for telephone operation, an attempt was made to get a very loud-speaking telephone and a powerful ringer. A telephone manufactured in Seattle was found in which two contacts are used, one on each side of the diaphragm. The two paths of the current being wound differentially in th repeating coil, a constant current is not obstructed but is shifted from one wire to the other with the vibrations of the diaphragm, thus permitting the use of high currents.

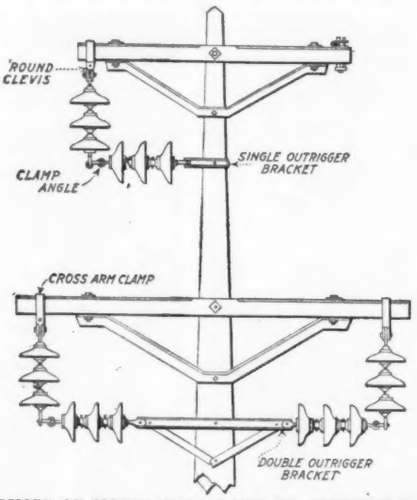
The transmitter at the power house is at the present time being successfully operated from the current of one of the 125-volt exciters through a variable resistance which allows a larger current to be maintained when the telephone lines are disturbed. In this way there can be maintained a much larger talking current in proportion to the induced current from the power wires. If the talking is too loud in the receiver, a variable-capacity reactor or resistor between the telephone lines can be used to reduce the volume. This reduces the talking current and the interfering currents in a virtually proportional degree. So far excellent results are reported.

On account of the number of telephones on the line, a stronger ringer was necessary, and this requirement has been met by W. V. Sylvester, one of the men of the department, who tried gearing together two ordinary magnetos connected in series. These are operated from one crank in the usual way and with no extra inconvenience.

CONDUCTOR SUPPORT FOR LINE CURVES AND ANGLES

Post Insulators Made Up of Disks Take Horizontal Strain and Keep Conductor in Position on Curves and Small Angles of High-Tension Lines

Instead of using dead-end construction or three strings* of star-arranged suspension insulators to keep conductors at the proper distance from cross-arms and poles on curves and small angles of 33,000-volt to 66,000-volt lines, the Minneapolis (Minn.) General Electric Company has developed the method shown herewith, using only two strings of insulators to each conductor. The disks are clamped together and the string attached to the 1-in. (2.5-cm.) channel-iron bracket. The single outrigger used on the upper conductor is bent to fit around the pole, whereas the double outrigger used for the two lower conductors is a straight piece of channel iron fastened to the pole at its center and held in position by two flat braces. To keep it from twisting, two flat braces are also attached to the opposite side of the pole.



RIGID STRINGS OF INSULATORS TAKE UP HORIZONTAL STRAIN

This arrangement permits using lighter and shorter cross-arms than would be required otherwise and uses no more insulators than are employed in dead-ending.

*The three-string method was described in the ELECTRICAL WORLD for July 13, 1918, page 64.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

A COLLECTION METHOD FOR ISOLATED COMMUNITIES

Meter Reader Now Makes Out Bills and Collects Amount Due Company Besides Making Small Repairs Where Required

BY P. M. CORDELL
Superintendent Meter Department, Choctaw Power & Light Company, McAlester, Okla.

Operating companies serving small towns and communities from their transmission lines are often at a loss as to the best procedure to follow in handling the consumers' accounts in the smaller and often isolated places. While with a company operating in Texas and serving a large number of towns and cities, it came to the writer's notice that a great deal of dissatisfaction was caused by the methods of collecting the accounts in places of thirty or forty or fewer customers.

The meter reader would go out from the district office and read the meters. Then bills would be made out and mailed to the customer from the district office, which is usually in the largest town of each district served. The practice was to arrange with the local bank to make the collections and forward them to the district office. This service was usually rendered the company gratuitously by the local bank, though in some instances there was a small charge made. This, however, was not satisfactory, because no effort was made to collect any delinquent amount that might be due the company, the collection agent merely collecting whatever amount the customer chose to pay.

There is no mail delivery in some of the smaller communities, hence the customer would have to go to the post office for his bill, and from there to the bank to pay it. Some of the customers expressed dissatisfaction with this manner of paying their monthly light bills, so it was decided to make a change. The man who reads the meters now makes out the bills, collects the money and gives a receipt at the time he calls to read the meter. It has been the writer's privilege to put this plan into operation in a small town in eastern Oklahoma very recently.

Previously the collections had been handled by the local bank, which was paid a small sum to handle this business. For various reasons, several of which have been stated, this plan was not satisfactory, and as the town served is seldom visited by any of the company employees and has a transient population, it was found that changes caused by one consumer moving out of and another moving into a house served were not properly cared for. This trouble has now been obviated.

Before making the change a letter was mailed to each customer explaining the new plan, and he was told that the meter reader would be in his town on a certain day each month to read the meter and collect the money for that month's bill. The meterman gets the bills from the bookkeeping department, all made out with the exception of the current month meter reading and kilowatt-hours consumed. The meter reader makes out the bill upon making the reading and collects the amount due less the discount. This plan has proved a success in the several towns where it has been tried. The consumer can now take advantage of the prompt-payment discount, and this alone has pleased the customers very much. It permits the company's representative to come into close contact with the customer and goes a long way toward establishing the cordial relation so much desired by the lighting company. Much can be done to make this relation more secure, as it requires only a few minutes of the meterman's time to fix a socket or mend a broken iron cord. No charge is made for these trivial repairs, as the good will established thereby is worth more in the long run than the revenue that might be had. The postage and stationery and office work saved by this plan more than pay for the slight additional time it requires to make out the bill at the time of reading the meter. Without an exception, the customers have expressed satisfaction at having their light bills handled in this way. The customer soon learns to expect the monthly visit of the meterman and has the money ready to pay him.

DEVELOPMENTS IN ELECTRIC TRUCKS AT HARTFORD, CONN.

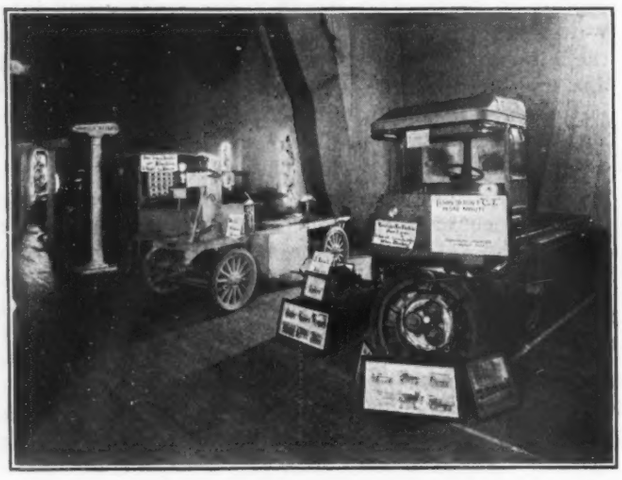
Gross Revenue from Ninety-two Trucks, Averaging Around $3,000 per Month, Shows a Very Substantial Improvement

With the close of hostilities a greatly improved outlook is now a striking feature of the electric road-truck market. Even in cities like Hartford, Conn., where the central station has enthusiastically pushed electric truck business for years, there is a better feeling about this class of service. The Hartford Electric Light Company maintained an extensive system of electric transportation all through the darkest days of the war, but the scarcity of labor and materials, combined with high

TABLE I—GROWTH OF ELECTRIC VEHICLE SERVICE AT HARTFORD, CONN.

	No. of Trucks in Use	Mileage for Month Named	Mileage to Date
June, 1910	3	272	272
December, 1910	5	3,196	15,573
June, 1911	6	2,915	31,396
December, 1911	14	8,639	82,317
June, 1912	18	11,757	138,925
December, 1912	30	15,207	218,894
June, 1913	32	24,873	347,636
December, 1913	46	32,751	574,900
June, 1914	50	38,614	727,345
December, 1914	58	40,787	978,526
June, 1915	64	47,615	1,232,967
December, 1916	84	48,044	2,040,900
June, 1917	88	53,197	2,312,071
December, 1917	82	28,182	2,601,704
June, 1918	92	35,903	2,802,373
December, 1918	91	26,642	3,012,757
January, 1919	92	27,179	3,039,936

prices for both, greatly reduced the number of machines on the streets as the war approached its climax. It is significant, however, that when the company asked all the users of its battery service system if they would like to have their money back on their equipment, every customer refused to consider such an offer. To the extent that drivers could be obtained or afforded at the unprecedented wages of $20 to $25 per week, the users of truck service continued in large measure to operate



ELECTRIC TRUCK EXHIBITION STAGED BY LIGHTING COMPANY

their equipments. Soon after the signing of the armistice the outlook began to improve, and the company is now supplying service to ninety-two trucks on the battery-mileage plan, the gross revenue averaging about $3,000 per month.

At the recent automobile show in Hartford a striking display of trucks was made in space supplied by the Hartford company free of charge to manufacturers and dealers. Five different trucks, manufactured by four different firms, each with a different type of drive, were shown and much interest was aroused.

The growth of central-station electric vehicle service at Hartford since June, 1910, when it was started, is shown in the accompanying Table I.

More than 3,000,000 miles of truck service have been furnished by the battery-service system at Hartford, and the total revenue received from this service from June, 1912, to January, 1919, was $176,547. The principal items covered in this revenue were gross battery expense and energy charges. A large part of the charging is done at night, so that the additional investment

TABLE II—SERVICE RECORD AND SIZE OF TRUCKS

No. of Trucks	Capacity, Lb.	Total Mileage Since Service Began	Total Car-Months
10	750	469,007	822
19	1,000	1,021,741	1,566
38	2,000	1,213,879	2,081
13	4,000	221,106	445
10	7,000	77,747	162
1	10,000	6,657	19

required in generating, transmission and distributing equipment to handle this business is practically negligible. To December, 1918, the average mileage per truck in service was 586 per month, without deductions for any cause. The total truck-months of service rendered was 5101, or over 400 years' experience in battery service, speaking mathematically.

The service record and sizes of trucks in operation in December, 1918, are shown in Table II.

TO POLULARIZE A COMPLETE JOB OF ELECTRIC SERVICE

Middle Western Company Will Devote Effort to Selling the Idea that the Home Should Have Sufficient Outlets, Switches, etc.

In its coming campaigns the Public Service Company of Northern Illinois will make an effort to induce each home owner who signs a contract for the equipment of his premises to have it made a complete job. He will be urged to specify the numerous auxiliary outlets for the use of lamps and appliances. One of the pieces of literature which are going out on this point reads as follows:

"When facts are known quality is desired. If the public knew no more about the automobile refinements than it does about electrical conveniences, automobiles would be sold minus lamps, starters, tops, wind shields and tools and would be equipped with undersized tires and one-cylinder engines. They would run, but that's all.

"Most house-wiring jobs give light and that's all. The public is buying electrical work on a price basis and is securing only half-completed jobs because it does not know any better.

"It is our work to show the public the advantages of oversized wiring, especially feeders, plenty of flush receptacles, switches, additional and emergency lighting outlets, and to have the people know about all electrical devices for the home. They should learn that there is a difference between electrical jobs."

UTILITY CO-OPERATES IN RENTING WIRED HOUSES

File in Hartford Company's Offices of Such Vacant Properties Consulted by 1049 Persons in First Twenty Days in March

The Hartford (Conn.) Electric Light Company inserted an advertisement about an inch long, Feb. 15, in a local daily stating that a list of wired houses and apartments available for rental had been placed on file at the company's offices for the convenience of the public. This was on a Saturday night, and the following Monday thirty-eight persons called upon the company in response to its invitation. The service was so much appreciated that a bulletin board about 30 in. by 40 in. in dimensions has been hung in the contract department, with vacant rentals listed by wards, and in the first twenty working days of March 1049 persons consulted the list. A large map showing the ward limits has also been hung in the department. Meters are allowed to remain for three months in vacated places, and the service the company has rendered has resulted in an increased demand for wired residences, many friends having been made by the company.

Some of the persons who benefited have written letters of thanks for the company's coöperation, and the local real estate men appear to be in hearty sympathy with the company's policy. The local electrical contractors are using the demand for wired apartments in interesting property owners in wiring, and house-wiring work was also considerably accelerated during March by the fact that a new wiring code extending the limits of the fire district took effect April 1. The rental service was suggested by George H. Allen, head of the contract department.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Large Motors for Reversing Mills.—The general features of two large reversing-mill motors having a peak power of 19,000 hp. and a speed variation of 60 to 140 r.p.m. are given in this article. The motor is of three-armature design and is said to possess advantages over the two-armature machines as follows: (1) As the diameter of the armatures is smaller than would be necessary in the case of a double-armature machine of the same power, the inertia is reduced and the operation of the mill is improved, owing to the more rapid acceleration obtained. (2) The distance between the centers is shorter and the weight on the bearings is less than in the case of a two-armature machine. (3) The total weight of the motor is divided into less weighty parts, thus facilitating handling. (4) This type of machine fulfills the requirements of standardization of parts, as by employing one, two or three of the separate units comprising the whole motor either 6500, 13,000 or 19,000 hp. is available.—London *Electrician*, March 14, 1919.

Use of Mica Insulation for Alternating-Current Generators.—H. D. STEPHENS.—The writer deals with mica for use in high-voltage, high-power alternators where the temperature is high and corona may exist. The futility of using paper or cloth insulations for such conditions is pointed out, and photographs are shown indicating the deterioration of such insulations under high temperature and corona conditions.—*Electrical Journal*, March, 1919.

Determination of the Efficiency of the Turbo-Alternator.—S. F. BARCLAY and S. P. SMITH.—Modern turbo-alternators invariably have forced ventilation, and practically all the losses except the bearing losses are carried off by the cooling air. Thus the most obvious method of finding the losses under load is to ascertain with regard to time the heat energy that is being carried away by the ventilating air. If the volume of the air flowing through the machine in unit time and the average increase of temperature that the air undergoes in absorbing the losses in the machine are known, then the total losses under load can be calculated. This method is referred to as the "air-heating" method. An alternative method (the "calibrated air-temperature" method) is to ascertain the increase in temperature of the cooling air caused by a loss of known magnitude in the alternator and from the observed temperature rise of the air under load to deduce the total losses. In the determination of the losses in the alternator from the cooling air the bearing losses are not included. These losses may be determined with fair accuracy by measuring the volume and temperature rise of the lubricating oil and by making a suitable allowance for the heat dissipated in other ways. These constitute only a small percentage of the total losses. The author discusses various methods of measuring the air velocity and the average temperature. For the measurement of air velocity the following methods are suggested: (1) the Pitot tube; (2) the Venturi tube; (3) electrical methods, and (4) the anemometer. Under electrical methods a scheme is suggested similar to that used with the gas meter, based on the law that an electrically heated wire in a current of air cools at a rate that is dependent on the velocity of the air current. It is said that a hot-wire velocity indicator operating on this principle has recently been devised by Prof. J. T. MacGregor-Morris. With the air-heating method the great advantage is that a driving motor is not required; also, when, on account of transportation difficulties, the stator has to be assembled on the site, in addition to measuring the total losses on load, the method could be employed to measure the separate losses with ease and accuracy. The "calibrated air-temperature" method has the one advantage compared with the "air-heating" method that the air volume does not have to be measured, but on the other hand it has certain disadvantages. For example, the efficiency cannot be determined solely by tests on site, and without the alternator a check test in the case of dispute cannot be made. The following table gives a comparison of results obtained by four different methods.

	Methods Based on Cooling Air		Methods Based on "Summation of Losses"	
Machine Number	"Air-Heating" Method	"Calibrated Air-Temperature" Method	A.I.E.E. Method	Stray Loss Ignored
5,862	352	362	336	211
7,001	327	338	315	255
7,541	46	47	52.5	42.8

—London *Electrician*, Feb. 28, 1919.

Lamps and Lighting

Industrial Illumination; Theory and Practice.—GEORGE K. MCDOUGALL.—A brief review of the elementary laws of light and suggestions for better lighting in factory, office and warehouse.—*Electrical News*, March 1, 1919.

Electricity in Household Service; Lighting.—E. J. EDWARDS.—Since the beginning of the electric lighting business about 1890, the cost of electric lighting has decreased about 85 per cent. This decrease has been due to improvements in the efficiency of incandescent lamps, to the decrease in their cost and to decreases in the cost of electrical energy, and it may be said that at the present time electric lighting is inexpensive, convenient and safe. The author takes up in detail the illumination of the rooms in households, showing the important considerations in each case and illustrating recommendations with photographs.—*General Electric Review*, March, 1919.

Apparatus for the Determination of the Spherical Candlepower of a Source of Light.—J. SAHULKA.—A device for the measurement of spherical candlepower is described which is somewhat similar in appearance to the Matthews photometer developed in America. It is said, however, that the mirrors are replaced with plaster-of-paris plates, which have the advantages that

it is only necessary that the light which reaches the photometer shall be proportional to the light intensity of the lamp and that the plates do not require to be adjusted to suit the distance of the lamp from the photometer.—London *Electrician*, Feb. 28, 1919.

Generation, Transmission and Distribution

Three-Phase Four-Wire Distribution.—GEORGE E. WAGNER.—In comparing the weight of copper required for the usual systems of distribution and assuming the weight of copper necessary for a single-phase circuit as 100 per cent, it is shown that the percentage of copper required for the various systems for the same load is as follows: Single-phase system, 100; two-phase four-wire system, 100; two-phase three-wire system, 73; three-phase three-wire system, 75; three-phase four-wire system 33. The advantages and limitations of the three-phase four-wire system are thus summarized: (1) The amount of copper required for transmitting the same load over the same distance is very much less than is necessary for any of the other systems. (2) The change to the four-wire system does not cause a change in voltage of the stepdown transformers, thereby permitting the use of the same transformers. (3) The four-wire system can be used for supplying current for light, heat and power purposes from one circuit, thereby overcoming the necessity of parallel circuits. This produces an additional saving in copper. In order to protect all parts of the circuit against excessive voltage to ground and to protect single-phase lighting transformers against excessive voltage, the neutral wire of a three-phase four-wire circuit should be grounded not only at the station but at a sufficient number of points along the line. (5) The neutral point of three-phase transformer banks should be isolated. (6) When the neutral point of a three-phase transformer bank is connected with the neutral wire of the circuit, the delta-connected secondaries tend to equalize the phase voltages. This should therefore not be done except on transformers of large capacity for a special purpose. (7) If a single-phase load is supplied from one phase of the delta-connected secondaries of a three-phase bank of transformers, the transformer on that phase will supply about one-half of the single-phase current and the other two transformers will supply the rest, whether the primary neutral point is connected to the neutral wire or not.—*Electric Journal*, March, 1919

Saving Steam in Industrial Heating Systems.—The discussion of the possible economies in steam-heating systems for factories are summarized as follows: (1) Avoid producing more exhaust steam than can be used at all times of the year, day and night. (2) If non-condensing units which will conform to rule 1 cannot be utilized for the power requirements, then operate non-condensing units only for such time, periods and load as will just balance the heating demand and have a unit or units of the most economical type to carry the rest of the purely power load. The same effect may sometimes be obtained by use of a bleeder type of steam turbine. Sometimes the most economical units for power only may be oil or gas engines. (3) Never use live steam for a purpose to which exhaust steam can be applied. (4) If a plant contains non-condensing units only, maximum efficiency is obtained when the production of exhaust is equal to or less than the heating demand, but never when an excess of exhaust is produced. When less exhaust is made than the quantity wanted, it is proper to draw live steam from the boilers to supply the deficiency. It is said that the value of exhaust steam compared to that of the hot returns is often misunderstood, so that very large losses in heat and fuel continue without correction. Where exhaust steam is substituted for live steam the saving will be approximately eight times that of returning an equal weight of hot drips.—*Technical Paper No. 221, Bureau of Mines.*

Extending the Life of Wood Poles.—CHARLES R. HARTE.—The seasoning of wood is a much more complicatd process than the mere drying out of contained water. Chemical changes occur in the contents and in the walls of the cells which have a marked effect upon the characteristics of the wood, but the amount of water content in the wood is the simplest and most universal test of seasoning. Many methods are in use for prolonging the life of the various woods. The author describes these and discusses their relative advantages, pointing out how different preservatives keep out and destroy the destructive germs. Photographs are shown which illustrate methods of reinforcing wood poles with concrete, removing dead wood and attaching iron-reinforced latticework in place. The N. E. L. A. and Western Union specifications for preservatives are reproduced. —*Electric Railway Journal*, March 22, 1919.

The Larger Undeveloped Water Powers of Tennessee. —JOHN A. SWITZER.—A review of a bulletin with this title was published in the ELECTRICAL WORLD of March 22, page 587. Unfortunately the name of the author was given as J. A. Fletcher. It should have been John A. Switzer.

Traction

Railroad Electrification Facts and Factors.—A. J. MANSON.—That the kind of current and supply voltage determine the power-collecting method used is discussed in full, together with diagrams showing methods of mounting and protecting third-rails.—*Railway Electrical Engineer*, March, 1919.

Rail Plateways.—Attention is called to the system of rail plateways advocated and described by G. Noble Fell some time ago. Plateways are not intended to compete with existing railways. They are to become feeders and to constitute a means of bringing traffic to the main railways. The rails are standard-gage and are designed to carry locomotives up to 25 tons weight. Estimates on the cost of this means of handling tributary traffic are set down.—*Electric Railway and Tramway Journal*, Jan. 10, 1919.

Effect of Tramways on Central Stations.—N. SCHULZ. —The financial results of the supply of energy for traction purposes and the effect produced on the profits of the undertaking are dealt with, the article being based on the results of the years 1912 and 1913 and forming a sequel to articles previously published by the author on the same subject.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elecktrot. Zeits.*, Oct. 10, 1918.)

Electric Battery Locomotives.—Excellent results are being obtained from the use of electric battery locomotives on freight sidings and other places where shunting and miscellaneous haulage are carried on. An illustration of one of the many electric battery locomotives made by the Brush Company for the Ministry of Munitions of England is shown. These battery locomotives are said to be ideal for factory purposes.—*Electric Vehicle*, December, 1918.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ALUMINUM, SOLDERS FOR.

The use, serviceability, method of application and composition of solders for aluminum have been investigated in the light of special tests made at the Bureau of Standards on commercial and other compositions of solders and also as a result of general experience with them. All soldered joints are subject to rapid corrosion and disintegration and are not recommended except where protection from corrosion is provided. Suitable compositions for solders are obtained by the use of tin with the addition of zinc, or both zinc and aluminum, within wide percentage limits.—*Bureau of Standards, Washington.*

ANEMOMETER, HOT WIRE, DROP-OF-POTENTIAL TYPE.

In this instrument the average velocity of flow of a gas is measured over a length of from 1 mm. to 3 mm. Two small 0.002-in. (0.05-mm.) platinum wires are attached about 2 mm. apart near the middle of the 0.007-in. (0.18-mm.) platinum heating wire. In calibrating and using it the current is measured that is required to maintain a certain potential drop—say 60 millivolts—between the two potential leads. A good portable potentiometer is sufficient for measuring the potential drop, while the current can be measured quite satisfactorily by use of a good ammeter of proper range.—*T. S. Taylor, Westinghouse Research Laboratories, East Pittsburgh, Pa.*

BEARINGS, SPRING-THRUST.

On larger bearings it is very difficult to establish and to maintain bearing surfaces fitting the journal within the limits of the thickness of the oil film. If this be not done, the metals will touch and the friction will greatly increase. In the new bearings the surfaces are made of thin flexible members supported in such a way that they can yield if overloaded over any small area. The usual support is by helical springs. The idea is to provide a bearing surface which is so yielding, flexible and elastic that it may conform to the rotating surface without creating at any point a unit pressure sufficient to destroy the oil film.—*H. G. Reist, Schenectady, N. Y.*

CONDUCTORS, AERIAL, WIND PRESSURE ON.

In connection with the preparation of the Electrical Safety Code, experiments have been made upon the shielding effect of several conductors with different directions of the wind. A tunnel was used in which the air velocity was controlled at will and the lateral pressure upon the conductors accurately determined. It has been found that the shielding effect of one conductor upon the other depends essentially upon the angle between the direction of the wind and the plane of the conductors. The shielding effect fell off rapidly as this angle was increased. No definite results could be accomplished in the open air.—*M. G. Lloyd, Bureau of Standards, Washington.*

IGNITION DEVICES, CALORIMETRIC STUDY OF SPARK.

Temperature curves were obtained which varied with the kind of thermometer used and with its position in the calorimeter. The pressure curves varied with the size and length of the pressure tubes. However, the same conditions were maintained in all the tests, and if the type of calorimeter used proves to be of practical value, it is proposed to work up specifications so that comparative results could be obtained anywhere by using common cheap supplies. It is interesting to note that the magneto giving the highest temperature curve does not necessarily give the highest pressure and vice versa. There seems to be some work to be done here.—*F. W. Springer, University of Minnesota, Minneapolis.*

ILLUMINATION, THE MEASUREMENT OF REFLECTION AND TRANSMISSION FACTORS.

A method has been developed for measuring the reflection and transmission of various light-diffusing media. The illuminating surface is a hemisphere of translucent glass inside a white-lined box. The material to be investigated is placed on a diametral plate and its brightness determined at definite angles by means of a photometer. This method is based on the principle involved in the Nutting absolute reflectometer, namely, two definite planes, one of which is opaque and receives all its illumination from the other. The relative brightness of the two planes measured with a comparison photometer is the absolute mean reflecting power of the opaque surface. Data have been obtained on ribbed and frosted glass. Numerous methods for investigating the optical properties of partly diffusing media were reviewed by the 1915 committee on glare in the *Transactions* of the Illuminating Engineering Society, pages 353-378, July, 1915.—*M. Luckiesh, Nela Park, Cleveland, Ohio.*

INDUCTANCE COILS, ELECTRICAL OSCILLATIONS IN.

Inductance coils may be treated from the standpoint of the theory of distributed inductance and capacity. Expressions have been derived for the reactance of a coil at any frequency and for the natural oscillations of a circuit of coil and condenser. It has also been shown that, in so far as the frequency of oscillation is concerned, an inductance coil with distributed characteristics is equivalent to a pure inductance of constant value with a constant capacity across its terminals. Excepting for skin effect, this pure inductance would be the same as the low-frequency inductance of the coil. This explains the fact which has been frequently observed experimentally, in particular for single-layer solenoids.—*John M. Miller, Bureau of Standards, Washington, D. C.*

MACHINERY, ELECTRICAL, SEPARATION OF LOSSES.

The machine under test is run idle as a motor at a constant speed, with various voltages impressed across the armature, the watts input to the armature being measured. In the case of a direct-current machine the excitation and the voltage are changed simultaneously so as to maintain constant speed. With a synchronous machine it is desirable to maintain approximately unity power factor. With induction machines the method is the usual idle running saturation current, the voltage being varied and the frequency kept constant. Volts are plotted as abscissas and the power input to the armature as ordinates. Assuming the curve to be a general parabolic one, the exponent of the parabola is computed and the curve extrapolated to the axis of ordinates; that is, to the voltage zero. The point so obtained on the axis of ordinates gives the value of the friction and windage loss. The remainder represents the core loss. The method will be described in detail in the A. I. E. E. *Proceedings.*—*C. J. Fechheimer, Pittsburgh, Pa.*

Apparatus Available

CONDENSERS, PRECISION.

The Bureau of Standards has constructed ten 0.01-mfd. air condensers, making a total of 0.1 mfd. These condensers were constructed for permanence and are not portable. They are mounted together on one table in such a way that any one or all may be connected to a given terminal. The condensers and all leads running from the condenser are carefully shielded so that the capacity is a definite quantity. In the construction of the condensers a minimum amount of insulating material was used, and this was so placed that it would not be in a strong electrostatic field. As a result, the condensers show no appreciable absorption and hence have the same capacity at all frequencies. The distance between the plates is 2 mm., this large distance being chosen in order that slight variations in plate distances shall produce the minimum effect on the capacity of the condenser. The condensers have been very satisfactory in service, the principal trouble arising from the fact that brass plates have not been thoroughly annealed.—*Bureau of Standards, Washington, D. C.*

Suggestions for Research

INSULATORS, LEAKAGE RESISTANCE.

Some measurements on surface resistivity of various materials have been published by the Bureau of Standards, in 1915, especially at 90 per cent air humidity. Among the materials that have the highest surface resistivity in damp air are paraffin, resin and sulphur, while glass and porcelain are among the lowest. L. New has recently shown experimentally the great advantage of insulators provided with a paraffin creepage surface (*Bulletin de la Societe Internationale des Electriciens*, Vol. 8, p. 83). The subject deserves serious attention on the part of insulator designers, especially with voltages at which the surface creepage and not the dielectric strength may be the determining factor.—*Editorial Suggestion.*

PERMEABILITY AT LOW DENSITIES.

Very little information is available concerning the permeability of iron and of its alloys in the region of minimum permeability occurring at very low densities. Iron has a low permeability of the order of 100 at exceedingly low densities, and this permeability is nearly constant throughout a certain range. Within this range the hysteresis effect is exceedingly small or negligible. When an iron core is used with a coil and when magnetic densities are within the range considered, the iron-core magnet has the advantages of an air-core magnet, namely, constant inductance and zero core loss, but has an enormously greater inductance. Further data concerning iron and alloys within this range would be of considerable value in special cases.—*R. W. Atkinson, Perth Amboy, N. J.*

SYNCHRONOUS MACHINES, TRANSIENT REACTANCE.

I should like to see some one investigate fully the influence of saturation on the transient reactance of, say, a turbo-alternator. We calculate the reactance of the winding and obtain results which are fairly accurate for normal values of current in the stator. But does this value hold with an excessively large current, such as obtained at the instant of short circuit? Owing to the saturation caused by the excessively large leakage fluxes, does not the winding behave as if it were located in a core of high reluctance? So far as I have been able to check this up, I believe this effect is present in 25-cycle generators, which are normally worked at fairly high tooth and core densities.—*R. B. Williamson, Milwaukee, Wis.*

TELEPHONE LINES, CAPACITY OF.

When a section of a telephone line with the arrangement of wires under consideration is not available for capacity tests, measurements can readily be made by the use of a satisfactory model. The capacities per unit length remain the same if all the dimensions of width and height are reduced in the same proportion. Furthermore, the conductivity or the permittivity of the medium may be increased. One suggestion would be to place the model in a tank of electrolyte with the vertical dimension corresponding to distances along the line. Some preliminary work of this sort was published by Dr. A. E. Kennelly many years ago, but considerable further study would be required to get the method into a form sufficiently accurate for our work, in which, in studying unbalances, we are interested in the small differences of relatively large capacities.—*H. S. Osborne, American Telephone & Telegraph Company, New York.*

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

LIST OF EXHIBITORS AT THE ATLANTIC CITY CONVENTION

Partial List Announced by Exhibition Committee of N. E. L. A.—Arrangements for Necessary Additional Space

An incomplete list of names of exhibitors at the exhibition to be held in connection with the National Electric Light Association convention during the week of May 19, at Atlantic City, has been made public by the exhibition committee.

While this is a partial list, it takes up the entire original allotment of space so that it has been necessary for the exhibition committee to arrange for additional space, which it has done to the extent of about 3500 sq.ft.

"From the number of applications coming in constantly we feel sure that this will not be sufficient to take care of the newcomers who desire to exhibit," says H. G. McConnaughy, secretary of the exhibition committee.

Following is the list made public by the committee:

Allis-Chalmers Manufacturing Company, Milwaukee.
American Conduit Manufacturing Company, Pittsburgh.
American Electrical Heater Company, Detroit.
American Ironing Machine Company, New York.
Albert & J. M. Anderson Manufacturing Company, Boston.
Baker R. & L. Company, Cleveland.
Borne-Scrymser Company, New York.
Central Electric Company, Chicago.
Commercial Truck Company of America, Philadelphia.
George Cutter Company, South Bend.
Delta-Star Electric Company, Chicago.
Detroit Stove Works, Detroit.
Edison Electric Appliance Company, Chicago.
Edison Storage Battery Company, Orange, N. J.
Electric Service Supplies Company, Philadelphia.
Electric Storage Battery Company, Philadelphia.
Electric Vacuum Cleaner Company, Cleveland.
Electrical Record, New York.
Electrical Review Publishing Company, Inc., Chicago.
Electrical Testing Laboratories, New York.
ELECTRICAL WORLD, New York.
Elliott-Fisher Company, Harrisburg, Pa.
Eureka Vacuum Cleaner Company, Detroit.
Federal Sign System (Electric), Chicago.
General Electric Company, Schenectady.
G & W Electric Specialty Company, Chicago.
Hoover Suction Sweeper Company, New Berlin, Ohio.
Hubbard & Company, Pittsburgh.
Hurley Machine Company, Chicago.
Independent Lamp & Wire Company, New York.
International Time Recording Company, New York.
Jeffery-Dewitt Insulator Company, Huntington, W. Va.
H. W. Johns-Manville Company, New York.
Landers, Frary & Clark, New Britain, Conn.
Leeds & Northrup, Philadelphia.
McGraw-Hill Company, Inc., New York.
Metropolitan Engineering Company, Brooklyn, N. Y.
Moloney Electric Company, St. Louis.
Naugle Pole & Tie Company, Chicago.
Norris Iron Works, Long Island City.
Ohio Brass Company, Mansfield, Ohio.
Packard Electric Company, Warren, Ohio.
Palmer Electric & Manufacturing Co., South Boston.
Philadelphia Electric Company, Philadelphia.
Philadelphia Electrical & Manufacturing Co., Philadelphia.
Pittsburgh Transformer Company, Pittsburgh.
Railway & Industrial Engineering Company, Pittsburgh.
Rathbone Sard Electric Company, Albany, N. Y.
Remmert Manufacturing Company, Belleville, Ill.
Rumsey Electric Company, Philadelphia.
Sangamo Electric Company, Springfield, Ill.
Simplex Electric Heating Company, Cambridge, Mass.
Square D Company, Detroit.
Tabulating Machine Company, New York.
Wagner Electric Manufacturing Company, St. Louis.
Walker Vehicle Company, Chicago.
Ward Motor Vehicle Company, Mount Vernon, N. Y.
Western Electric Company, New York.
Westinghouse Electric & Mfg. Co., East Pittsburgh.
C. H. Wheeler & Company, Philadelphia.

Additional names and also details of the new plan will be made public is soon as arrangements are completed.

LAMP COMMITTEE EXHIBIT AT ATLANTIC CITY CONVENTION

Frank W. Smith Says that the Presentation of "the New Spirit of Lighting" Will Be a Revelation of Opportunities

Frank W. Smith, chairman of the lamp committee of the National Electric Light Association, is taking steps to attract general attention to the exhibit of "the new spirit of lighting" which is to be a feature of the convention at Atlantic City during the week beginning May 19. He believes that this exhibit will be of great educational value and will stimulate progress and development. It is desired to encourage the largest possible attendance at the exhibit and careful study of the lessons which the lighting displays will carry. Details of the proposed exhibit were published in last week's issue of the ELECTRICAL WORLD.

"The exhibit is made possible," said Mr. Smith to a representative of the ELECTRICAL WORLD, "by the splendid coöperation of the lamp manufacturers, who will bear the principal burden of the preparation and conduct of the exhibit. The lighting sales bureau of the Commercial Section is actively coöperating with the lamp committee and with the manufacturers in securing the best results.

"The plan to hold the exhibits is one that was under consideration for the 1917 convention but was abandoned under the stress of war conditions. In part it will represent what has been learned during the war period. The entire exhibit will be, we think, a new revelation to many people of the opportunities in the adaptation of lighting to many fields of usefulness.

"It is confidently felt that a great development in lighting will be seen in the post-war period in this

country. Public interest has been stimulated in the question of adequate lighting. The industrial benefits of proper lighting are better appreciated than ever before. There is more readiness on the part of users to listen to the message which the central-station illuminating engineer bears. We want to be sure that central-station managers and salesmen are thoroughly alive to the opportunities before them. The lighting exhibit will emphasize the importance of the subject in a new way. It will be instructive and practical.

"An effort will also be made to tie the exhibit in with part of the program of the lighting sales bureau of the Commercial Section. But the exhibit itself is to be so comprehensive that we hope that it will appeal to every delegate at the convention."

Mr. Smith said that the lamp committee will regard the exhibit in part as illustrating the committee's report, which will be made before the convention in the usual form. Questionnaires for some of the data have been sent to member companies, and it is stated that up to this time nearly 50 per cent of replies have been received. This will enable the committee to bring up to date the information concerning the lamp practice of member companies reported in 1917. It will be fully illustrated by charts, curves, etc., in that part of the exhibit devoted to "company lamp practice."

To simplify the questionnaire the committee compiled its inquiries so that the companies might indicate their practice on the different points by simply placing a mark after the particular statement which shows their policy. The questions deal with the policy as to giving free renewals on merchandising, allowance for claims on account of defective lamps, wattage limits of lamps supplied free, identification of consumer or lamps to obtain free renewals, method of deliveries, approximate percentage of lamps used by customers which are obtained by the company, methods used in advising consumers in regard to proper use of lamps to obtain best illumination, and statement of length of period in which practices described have been in effect.

LISTEN! PRIZE CONTEST FOR N. E. L. A. CONVENTION

Victory Liberty Bonds to Be Given by Exhibition Committee for Best Articles on Exhibit of Manufacturers at Atlantic City

Lay down the pliers, take up the pen, sit on the beach and write what you think about the electrical manufacturer. Thus the exhibition committee of the National Electric Light Association announces a prize contest in connection with the Atlantic City convention of the National Electric Light Association. Prizes will be awarded for articles giving the impressions of delegates on the exhibition as a whole. The following rules will govern:

(1) Every contestant must be a Class "B" member of the N. E. L. A.

(2) All Class "B" members except those engaged in publicity and advertising are eligible to compete.

(3) Every contestant must have manuscript in the hands of the judges by June 1, manuscripts not to exceed 2000 words and to bear the name, address and occupation of the contestant.

A board of judges selected by the president of the National Electric Light Association will decide on the best three stories and will award first, second and third prizes, as follows: First prize, $150 in Victory Liberty bonds; second prize, $100 in Victory Liberty bonds; third prize, $50 in Victory Liberty bonds.

Prize-winning stories will receive early publication in the National Electric Light Association *Bulletin* and electrical trade papers.

In announcing the contest the committee calls attention to the fact that the real good that comes from an exhibition is mutual. It adds:

"The manufacturer, by his investment in space, apparatus and time, brings something and adds something to the convention itself and offers an opportunity to the central-station man to get "up-to-the-minute" information on appliances, methods and apparatus that improve his business or department. Conventions, like colleges, offer but a part of their educational advantages in the classroom. There is a world of knowledge to be learned on the campus—and the exhibition hall is a part of the convention campus. It is appreciated that the best possible advice to be obtained for future exhibits will come from the man who is closest to the use of the materials or appliances exhibited, and that an exhibition is good or poor to the extent that it helps central-station operation, maintenance, construction and selling."

ENTERTAINMENT AT THE ATLANTIC CITY CONVENTION

Tentative Outline for the National Electric Light Association Meeting — Wireless and Aeronautical Exhibits of Great Interest

T. I. Jones, chairman of the entertainment committee, has issued the following tentative program for the Atlantic City convention of the National Electric Light Association:

Monday, May 19

9 a.m.—Opening of exhibition, Million-Dollar Pier.

9:30 p.m.—Reception, followed by dancing, Million-Dollar Pier.

Tuesday, May 20

12:30-1:30 p.m. and 5-6 p.m.—Wireless telephone communication between land and flying aëroplanes; aëronautical exhibition, showing machine control and feats in flying, end of Million-Dollar Pier.

4 p.m.—Cards for the ladies—"auction bridge" and "five hundred" for prizes—Million-Dollar Pier.

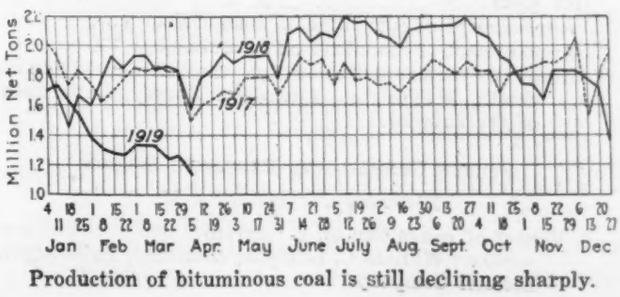
Wednesday, May 21

12:30-1:30 p.m. and 5-6 p.m.—Second wireless telephone communication; aëronautical exhibition.

4 p.m.—Ladies' tea and musicale, string orchestra, instrumental and vocal solists, Million-Dollar Pier.

9 p.m.—Carnival and ball, including illumination spectacle; special music, Million-Dollar Pier.

Decline in Bituminous Coal Production



Production of bituminous coal is still declining sharply.

Program for the N. E. L. A. Convention

Tentative Program for the Meeting to Be Held at Atlantic City During the Week Beginning May 19 Shows a Wide Range of Constructive Topics for Discussion and Action

FOLLOWING is the tentative program adopted for the forty-second annual convention of the National Electric Light Association, to be held at Atlantic City, N. J., on May 19 to May 22, 1919:

FIRST GENERAL AND EXECUTIVE SESSION

Tuesday, May 20, 10 A.M.

1. Welcome to the city by Mayor Harry Bacharach.
2. Address of the president, W. F. Wells, Brooklyn Edison Company, Inc.
3. Appointment of committee on president's address.
4. Announcements.
5. Report of the acting secretary, S. A. Sewall, New York.
6. Report of insurance expert, W. H. Blood, Boston, Stone & Webster.
7. Report of rate research committee; Alex Dow, chairman, Detroit Edison Company.
8. Progress report of special joint committee on determination of power factor in polyphase unbalanced circuits; R. J. McClelland, chairman, New York, Electric Bond & Share Company.
9. Paper, "The Electric Truck in Modern Transportation," E. E. LaSchum, New York, general superintendent American Railways Express Company.

SECOND GENERAL AND EXECUTIVE SESSION; THE PUBLIC POLICY SESSION

Tuesday, May 20, 9 P.M.

1. Paper, "Sale of Securities to Customers and Resident Citizens," W. H. Hodge, Chicago, H. M. Byllesby & Company.
2. Report of public policy committee; W. W. Freeman, chairman, Cincinnati, Union Gas & Electric Company.
3. Report of National Committee on Gas and Electric Service; J. W. Lieb, chairman, New York City, New York Edison Company.
4. Address, "The Trend of Socialism," F. G. R. Gordon, Haverhill, Mass.

THIRD GENERAL AND EXECUTIVE SESSION

Wednesday, May 21, 10 A.M.

1. Report of the treasurer, Frank W. Smith, New York City, United Electric Light & Power Company.
2. Election of nominating committee.
3. Report of membership committee; Walter Neumuller, chairman, New York City, New York Edison Company.
4. Report of committee on company sections; F. A. Birch, chairman, Philadelphia Electric Company.
5. Report of committee on constitution and by-laws; William C. L. Eglin, chairman, Philadelphia Electric Company.
6. Appointment of committee on memorials.
7. Appointment of committee on resolutions.
8. Address, "Regional Power Systems," Dr. George Otis Smith, Washington, Geological Survey, Department of the Interior.

FOURTH GENERAL AND EXECUTIVE SESSION

Thursday, May 22, 10 A.M.

1. Report of committee on safety rules and accident prevention; William C. L. Eglin, chairman, Philadelphia Electric Company.
2. Report of lamp committee; Frank W. Smith, chairman, New York City, United Electric Light & Power Company.
3. Paper, "The Importance of Electrochemistry," Prof. Joseph W. Richards, Lehigh University, secretary of American Electrochemical Society.
4. Report of committee on form of annual report to commissions; W. J. Meyers, chairman, New York City, United Electric Light & Power Company.
5. Report of committee on Billings and Doherty prizes; A. S. Loizeaux, chairman, Baltimore Consolidated Gas, Electric Light & Power Company.
6. Report of committee on president's address.
7. Report of committee on constitutional amendments.
8. Report of committee on memorials.
9. Report of committee on resolutions.
10. Report of national nominating committee.
11. Election and installation of officers.

TENTATIVE PROGRAM, COMPANY SECTIONS

Wednesday, May 21, 6:30 P.M.

Company sections' dinner.

TENTATIVE PROGRAM, ACCOUNTING SECTION

Tuesday, May 20, 2 P.M.—First Accounting Session

1. Chairman's address, Paul R. Jones, New York, Henry L. Doherty & Company.
2. Election of nominating committee.
3. Report of committee on cost accounting and statistics; A. D. Spencer, chairman, Detroit Edison Company.
4. Report of committee on commission accounting rulings; H. E. Addenbrooke, chairman, Chicago, Commonwealth Edison Company.
5. Report of committee on accounting education; H. B. Lohmeyer, chairman, Consolidated Gas, Electric Light & Power Company of Baltimore.

Wednesday, May 21, 2 P.M.—Second Accounting Session

1. (a) Report of committee on operating records; C. A. White, chairman, Edison Electric Illuminating Company of Boston.
   (b) Address, "Experience with Government Transportation," H. B. Lohmeyer, Consolidated Gas, Electric Light & Power Company of Baltimore.
2. Report of committee on purchasing and storeroom accounting; W. F. Stevens, chairman, Edison Electric Illuminating Company of Boston.
3. Report of committee on accounting service to member companies and the monthly bulletin; Frederick Smith, chairman, New York Edison Company.
4. Report of committee on customers' records and billing methods; H. C. Schlegel, chairman, New York Edison Company.
5. Address, "The Importance an Efficient Accounting Department Is to a Business," Col. H. A. Gidney, Boston, Charles H. Tenney & Company.
6. Report of nominating committee on section officers.
7. Election of section officers.
8. Adjournment.

TENTATIVE PROGRAM, COMMERCIAL SECTION

Tuesday, May 20, 2 P.M.—First Commercial Session

1. Chairman's address, Charles J. Russell, Philadelphia Electric Company.
2. Report of committee on finance; John G. Learned, Chicago, Public Service Company of Northern Illinois.

3. Appointment of nominating committee.
4. Report of committee on commercial service and relations with customers; R. F. Bonsall, Consolidated Gas, Electric Light & Power Company of Baltimore.
5. Report of committee on wiring; R. S. Hale, Edison Electric Illuminating Company of Boston.
6. Report of committee on education of salesmen; Fred R. Jenkins, Chicago, Commonwealth Edison Company.
7. Report of committee on electric salesmen's handbook; R. H. Tillman, Consolidated Gas, Electric Light & Power Company of Baltimore.

Wednesday, May 21, 2 P.M.—Second Commercial Session—Lighting Sales Bureau

1. Chairman's address, C. L. Law, New York Edison Company.
2. Report of committee on commercial aspects of lamp equipment; O. R. Hogue, Chicago, Commonwealth Edison Company.
3. Report of committee on commercial aspects of street and highway lighting; C. G. Durfee, Rochester, Rochester Railway & Light Company.
4. Report of committee on residence lighting; C. W. Johnson, Jackson, Hodenpyl, Hardy & Company.
5. Report of committee on outdoor lighting; H. H. Magdsick, Cleveland, National Lamp Works.
6. Report of committee on electrical advertising; E. A. Mills, New York Edison Company.
7. Report of committee on store lighting; A. L. Powell, Harrison, General Electric Company.
8. Report of committee on lighting of public buildings; G. Bertram Regar, Philadelphia Electric Company.

Wednesday, May 21, 2 P.M.—Third Commercial Session—Power Sales Bureau

1. Discussion, "Effect of the War on Isolated Plant Costs"; discussion led by I. Lundgaard, Rochester Railway & Light Company.
2. Discussion, digest 1917 report of electrical heating bureau, "Electric Heating of Non-Ferrous Metals"; C. F. Hirshfield, Detroit Edison Company.
3. Paper, "Electric Furnaces." (a) Non-ferrous metals; discussion led by N. T. Wilcox, Keokuk, Mississippi River Power Company. (b) Steel; discussion led by Morse DellPlain, Hammond, Northern Indiana Gas & Electric Company.
4. Paper, "Power Factor in Customers' Installations"; discussion led by R. H. Knowlton, Philadelphia, United Gas Improvement Company.

Wednesday, May 21, 3:45 P.M.—Fourth Commercial Session—Electric Range Committee

1. Discussion, commercial information and recommendations; discussion led by J. F. Killeen, Chicago, Edison Electric Appliance Company.
2. Discussion, technical features of the electric range business; discussion led by Hartwell Jalonick, Dallas, Texas Power & Light Company.
3. Discussion, water heating by electricity.

Wednesday, May 21, 6:30 P.M.—Power Sales Bureau Dinner

1. Discussion, electric welding; discussion led by F. E. Richards, Newark, Public Service Electric Company.
2. Paper, "Electric Industrial Trucks and Tractors and Their Relation to the Central-Station Load"; E. J. Bartlett, Cleveland, Baker R and L Company.

Thursday, May 22, 2:30 P.M.—Fifth Commercial Session

1. Report of committee on publications; F. D. Pembleton, Newark, Public Service Electric Company.
2. Report of committee on coördinate advertising and sales campaigns; Henry Harris, Pittsburgh-Duquesne Light Company.
3. Report of committee on merchandising; E. R. Davenport, Providence, Narrangansett Electric Lighting Company.
4. Report of nominating committee.
5. Election of section officers.
6. Demonstration, industrial lighting equipment; William A. Durgin, Chicago, Commonwealth Edison Company.
7. Adjournment.

TENTATIVE PROGRAM, ELECTRIC VEHICLE SECTION

Tuesday, May 20, 2 P.M.—First Electric Vehicle Session

1. Chairman's address; E. S. Mansfield, Boston, Edison Electric Illuminating Company.
2. Report of secretary.
3. Report of treasurer.
4. Report of committee on federal and municipal transportation; James H. McGraw, chairman, New York, McGraw-Hill Publishing Company.
5. Report of committee on garage and rates; C. H. Miles, chairman, Edison Electric Illuminating Company of Boston.
6. Report of committee on legislation; G. A. Freeman, chairman, Chicago, Walker Vehicle Company.
7. Report of committee on manufacturers and central-station coöperation; George B. Foster, chairman, Chicago, Commonwealth Edison Company.
8. Report of committee on standardization; E. R. Whitney, chairman, Philadelphia, Commercial Truck Company of America.
9. Report of operating records committee (Accounting Section); C. A. White, chairman, Edison Electric Illuminating Company of Boston.
10. Report of transportation engineering committee; F. M. Feiker, chairman, New York City, ELECTRICAL WORLD.
11. Appointment of nominating committee.
12. Paper, "The Present and Future Status of the Electric Vehicle"; Rodney K. Merrick, Philadelphia, Commercial Truck Company.
13. Paper, "The Electric Vehicle from a Salesman's Standpoint"; J. B. M. Cordoza, New York, Walker Vehicle Company.

Wednesday, May 21, 2 P.M.—Second Electric Vehicle Session

1. Paper, "A Message from Electric Vehicle Users"; George B. Foster, Chicago, Commonwealth Edison Company.
2. Report of nominating committee.
3. Election of officers.
4. Paper, "The Proper Application of the Electric Vehicle"; F. F. Sampson, New York, Exide Battery Depots.
5. Paper, "Electric Industrial Trucks and Tractors and Their Relations to the Central-Station Load"; E. J. Bartlett, Cleveland, Baker R. & L. Company.
6. Questionnaire containing various subjects for discussion.
7. Adjournment.

TENTATIVE PROGRAM, TECHNICAL AND HYDROELECTRIC SECTION

Tuesday, May 20, 2 P.M.—First Technical Session

1. Chairman's address, R. J. McClelland, New York City, Electric Bond & Share Company.
2. Appointment of nominating committee.
3. Report of committee on prime movers; N. A. Carle, chairman, Newark, Public Service Electric Company.

Tuesday, May 20, 2:30 P.M.—Second Technical Session

1. Report of committee on underground construction and electrolysis; E. B. Meyer, chairman, Newark, Public Service Electric Company.
2. Report of committee on overhead lines and inductive interference; A. E. Silver, chairman, New York City, Electric Bond & Share Company.

Wednesday, May 21, 2 P.M.—Third Technical Session

1. Report of committee on electrical apparatus; R. F. Schuchardt, chairman, Chicago, Commonwealth Edison Company.
2. Report of committee on meters; F. V. Magalhaes, chairman, New York Edison Company.
3. Report of nominating committee.
4. Election of officers.
5. Adjournment.

"ELECTRIFY YOUR HOME" CAMPAIGN DOING WELL

Edward N. Hurley Writes Society for Electrical Development on Necessity for Electrical Industry to Do Its Part Toward Prosperity

"Electrify your home," the national house-wiring campaign launched by the Society for Electrical Development, is well under way in 400 cities throughout the country. Many letters approving the campaign to energize electrical activities have been received by the society from prominent men in the industrial and official world.

Edward N. Hurley, chairman of the United States Shipping Board, in a letter to J. M. Wakeman, general manager of the society, makes an interesting survey of the post-war problems of readjustment. Mr. Hurley says:

While we have many great problems brought about by the violent changes from peace to war and from war to peace, yet these are in process of readjustment, and from my point of view the certain way to resume business is to resume. If people make up their minds business is going to be good, it will be good. It is going to be good anyway, but that is the short cut.

In order to go over a grade you must take a run for it, whether you are in an automobile or a locomotive. And all that the electrical or any other of our industries has to do to go over the top is for salesmen to go out and make sales. There is an abundance of money to care for the result.

I am keenly interested in the success of the electrical industry and am glad to know that the Society for Electrical Development is again endeavoring to arouse the electrical industry to the necessity of doing its part toward hastening prosperity.

The world wants American electrical products. We now have the ships ready for carrying these products to the markets of the world. Please pay close heed to this: In the future the leaders of the electrical industry, as well as the leaders in other of our industries, must not only think nationally, they must think internationally. For in foreign markets we have the greatest opportunity ever presented to any nation. Moreover, we now have the ships for carrying the enormous volume of manufactures and products which this nation is capable of supplying.

OHIO WORKS TO IMPROVE INDUSTRIAL LIGHTING

Campaign of Illumination Committee of Ohio Electric Light Association Includes Meetings at Columbus, Toledo and Akron

The illumination committee of the Ohio Electric Light Association held three meetings last week—at Columbus on April 9, at Toledo on April 10 and at Akron on April 11. These followed the conclusion reached by the committee several months ago that the time was ripe for an active campaign in behalf of improved industrial lighting. Among the considerations that led them to this conclusion were the growing evidence as to the increased production resulting from the use of high lighting intensities, the approaching completion of the factory lighting code of the Industrial Commission of Ohio and the general demand for higher efficiency in manufacturing methods, resulting from war conditions.

Among the various lines of attack that were decided upon by the committee were the series of special meetings mentioned and a sort of correspondence course for the benefit of the member companies.

The three meetings held last week were at points most accessible to the lighting men of the association. With the exception of one address by a local central-station man, the program was the same at all the meetings and was designed both to impress upon the lighting men the importance of the work which they were undertaking and to supplement, by lectures and demonstrations, the correspondence work. The morning sessions were closed conferences at which the work to be done was talked over by the members of the committee and the lighting men. The afternoon meetings were open to all persons interested and were attended by electrical contractors, industrial managers and others besides the central-station men. The programs were divided about equally between the commercial and the more technical aspects of the work.

Coöperation was the subject of an address by George W. Hill, who was sent from New York by the Society for Electrical Development to assist the committee in its undertaking. The need for the central stations and the electrical contractors to work together cordially was the special theme of Mr. Hill's plea. Short talks along similar lines, based largely upon their own experience, were given in their respective cities by W. A. Walls of the Columbus Railway, Power & Light Company, W. E. Richards of the Toledo Railways & Light Company and D. MacNaughton, formerly of the Northern Ohio Traction & Light Company. "Illumination Design," illustrated with lantern slides and demonstrated with various types of factory-lighting units, was the subject of a lecture by H. H. Madgsick of the engineering department, National Lamp Works of the General Electric Company. The program was closed with a short talk on the measurement of illumination by the chairman of the committee. This was accompanied

by a demonstration of several types of illumination-measuring instruments.

It is believed that these meetings have done much to create and extend interest in industrial lighting. Up to date about sixty companies have selected their representation for this work.

In the conduct of the correspondence course for the member companies each company was invited to appoint a member of its sales-engineering staff as the "lighting man" of their organization. To these lighting men the committee is sending a series of communications known as "policy letters." These letters are designed to give the men the latest information concerning developments in industrial illumination, methods of presenting these to factory managers and other suggestions which should assist them in conducting the campaign for improved lighting in their various communities.

It soon became evident that, owing both to the limited attention which it has been practicable to give to lighting problems in recent years and to the rapid developments of the lighting art during this period, very few of the companies had men on their staffs who possessed the technical information needed to qualify them for this work. On this account the department of electrical engineering of the Ohio State University was persuaded, in coöperation with the committee, to publish a series of technical letters on industrial illumination, to be used in conjunction with the policy letters mentioned above.

These "technical letters" are of a practical character. They begin with the elementary principles of the subject and treat it from every point of view needed by the man who has charge of the design and maintenance of such illumination. They are unique in that instead of endeavoring to include all of the required information they depend largely upon references to the technical trade literature, of which there is such an abundant and well-written supply in the lighting field. In contributing this material the manufacturers of lamps and accessories have coöperated most cordially. In the interest of improved illumination this series of technical letters is being offered to any one interested, at $2 each.

The members of the Ohio Electric Lighting Association illumination committee who have this work in charge are G. S. Merrill, engineering department National Lamp Works of the General Electric Company, Cleveland, Ohio; E. H. Beil, Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, and F. C. Caldwell, chairman, Ohio State University, Columbus, Ohio.

TELEPHONE STRIKE HITS FIVE NEW ENGLAND STATES

Demands for Increased Pay and Dissatisfaction with Proposed Method of Settlement Lead to Break in Service

A strike of more than 6000 operators of the New England Telephone & Telegraph and Providence Telephone companies began at 7 o'clock on Tuesday morning of this week, tying up service in practically all of New England except Connecticut and directly affecting nearly 750,000 subscribers. Demands for increased pay, coupled with dissatisfaction regarding the method of adjustment proposed by the Postmaster-General and the telephone companies, are involved in the walkout.

The operators seek a wage scale ranging from $10 per week on assignment to duty to $22 at the end of four years' service, with supervisors' pay ranging from $23.50 to $25. The previous scale, which expired Dec. 31, 1918, included the following rates: Training period, usually three weeks, $6 per week; student period, usually seven weeks, $7; end of three months, $7.50, with increases to a maximum of $16 for seven years and over. Junior supervisors received $10 to $17 and supervisors from $17 to $19.

The operators claimed that their inability to deal with the company officials as under private management has led to fruitless efforts to obtain a decision from the Post Office Department through a period of several months, and the companies maintained that the procedure advised by the Postmaster-General should be followed in settling the dispute, namely, to submit the schedule first to the companies, then to the operating board in New York, then to the wire control board in Washington and lastly to the Postmaster-General, on whose recommendation the entire scale to be adopted depends.

An enormous amount of extra business was thrown upon the telegraph companies as a result of the strike. With the exception of a few very small places the tie-up was practically complete on Tuesday, and it was virtually impossible at the time of writing to estimate the loss sustained by business interests or to appreciate the amount of personal suffering resulting from the walkout. Vigorous efforts were made by the public authorities and by powerful business organizations to prevent the strike, but all attempts at postponement were futile. On Tuesday attempts were made by the companies to provide a measure of emergency service for hospitals, public utilities and the government, but little beyond interior communication was available.

LIGHTING LEGISLATION DISCUSSED IN NEW YORK

Outline of Principles of Several State Codes Given Before Joint Meeting of Electrical and Illuminating Engineers

Safeguarding of the life, limbs and vision of industrial workers and increasing the earning power of both the workers and the industrial plants were stated to be the main functions of industrial lighting codes, by G. H. Stickney of the Edison Lamp Works of the General Electric Company, in a paper presented before a joint meeting of the American Institute of Electrical Engineers and the Illuminating Engineering Society on April 11 in New York. Industrial lighting codes based on the Illuminating Engineering Society's rules are now in force in Pennsylvania, New Jersey, New York, Wisconsin and Oregon, and in several other states similar codes have been drawn up and are under consideration for adoption. In spite of the recent general improvement in industrial lighting practice, the increasing need of ample assurance in this matter is evident from the present tendencies of manufacturers, among which may be mentioned the following: The grouping of larger numbers of employees, the extension of all-night processes, increasing use of dangerous machinery, intricacy of processes, and specialization of workers who have to sustain close visual application. It has been the experience of labor commissions that at least 90 per cent of the manufacturers cordially desire to comply with their regulations. The principal difficulty so far encountered in applying the code has been to make clear to the layman just what is required and just how it can be obtained. It has, therefore, been found expedient to publish supplementary educational sections.

The principal lighting specifications common to all states which have adopted the code are intensity, glare limits and distribution. In drawing the specifications it has been constantly recognized that they must be kept simple and practicable so that conformance may be determined without recourse to lighting experts or bulky and expensive instruments. On the other hand, it is desirable to make the specification as definite as possible, minimizing the part left to the individual judgment and thus avoiding controversy and prejudice. In all codes which have so far been enacted the intensity is specified in foot-candles. While at first some difficulty was experienced in explaining these values and providing for their measurement, the development of a simple and inexpensive foot-candle meter, described elsewhere in this issue, has facilitated the application of the specifications.

The establishment of proper limits for glare is probably more important than the matter of intensity. It seems to be general that more employees suffer from glare than from insufficient light. Distribution of light, emergency lighting and switching of controlling and enforcement were also discussed by Mr. Stickney. In dealing with lighting codes he made an attempt to emphasize the principles involved rather than the details. Change in details may be expected, but any considerable change in principles seems unlikely. No one is more conscious of the limitations of the code in its present form than the illuminating engineers who have been active in its development. Mr. Stickney pointed out that manufacturers were glad to have codes adopted because of the economies of standardization.

Discussion

Prof. C. E. Clewell, University of Pennsylvania, observed that codes are new and different from the regulations usually supplied to state inspectors and that inspectors should be posted on fundamentals. The three main points, he thought, were that enforcement calls for education, that inspectors should have simple devices to check their opinions and that the human element in the inspector's judgment should be eliminated by supplementing the code and gathering inspectors together to give them instructions. Professor Clewell spoke about the Museum of Safety in New Jersey, which contains various kinds of lighting systems, enabling manufacturers and inspectors to see what sort of installations are desirable.

The educational value of these codes should be emphasized to a much larger degree than the legal value, according to Dr. E. B. Rosa of the Bureau of Standards. There should be educational information for preparers of codes, engineers, employers and employees. He also thought that the codes should be put on trial before they are adopted.

C. B. Aul of the Westinghouse Electric & Manufacturing Company criticised the method of having different codes for each state, because, he said, it is a disadvantage to manufacturers and others trying to obtain standard requirements. He said the intensities outlined in the majority of the codes are too low, and that the effect of dirty lamps is not emphasized as it should be. Some method should be obtained to insure distribution of light on the work. It is ridiculous to have duplicate emergency circuits in operation all of the time because sufficient assurance is given by means of an auxiliary circuit which is switched off by a relay when the regular lights are disconnected by some accidental means.

Dr. M. G. Lloyd of the Bureau of Standards told about the safety work of the bureau and said that the requirements for lighting were included in building construction specifications of the N. E. S. C. He also said that federal lighting standards closely followed the Illuminating Engineering Society standard code and told of some of the general rules and other requirements made by the government. The recent Oregon law, according to Dr. Lloyd, does not include definite quantity values but gives the commission power to fix general intensity and conditions of glare, distribution and emergency lighting.

Ward Harrison of the National Lamp Works of the General Electric Company said that the most difficult thing to measure in illumination was glare and that engineers had been working for some time on a glareometer for telling when the correct lighting was provided.

John H. Vogt, chemical engineer of the New York Industrial Commission, said that up to March 1, 1919, 3290 orders for changes in lighting had been given and that 1569 compliances had been secured. He remarked that there does not seem to be any particular difficulty in getting manufacturers to change their systems.

Other engineers discussing the paper were W. T. Blackwell, Benjamin Manufacturing Company; E. D. Perrot of Bollinger & Perrot, and Norman Macbeth of the Artificial Daylighting Company.

Mr. Stickney said, in closing the discussion, that the code tells what is to be maintained in lighting intensity and not (except in the supplement) how it is to be maintained.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

N. E. L. A., Philadelphia Electric Company Section.—On April 15 the engineering branch meeting of this section of the National Electric Light Association was addressed by W. T. Watson, whose subject was "Transportation."

Massachusetts Electrical Contractors' Association.—On March 26 a Connecticut Valley Branch of the Massachusetts Electrical Contractors' Association was formed, with Frank Haskell and Ernest Bishop, both of Holyoke, Mass., as chairman and secretary-treasurer, respectively.

N. E. L. A. and A. I. E. E., Portland Sections.—J. W. Sadler, Great Northern Concrete Shipbuilding Company, addressed the Portland Sections of the American Institute of Electrical Engineers and the National Electric Light Association at their joint meeting of April 7 on the subject of "Concrete Ships."

Tri-State Water and Light Association.—The next convention of the Tri-State Water and Light Association of the Carolinas and Georgia will be held at Greenwood, S. C., on June 17, 18 and 19. W. F. Stieglitz, secretary-treasurer and convention manager, says that programs for the meetings will be available on June 1.

A. I. E. E., Erie Section, and Engineering Society of Northwestern Pennsylvania.—On May 13 Vladimir Karapetoff, professor of electrical engineering at Cornell University, will address the Erie Section of the American Institute of Electrical Engineers and the Engineering Society of Northwestern Pennsylvania on "Electro-acoustic Shock Signaling." Professor Karapetoff has been investigating this subject for industrial concerns and will demonstrate his lecture with working models, signaling codes and numerous lantern slides.

O. E. L. A., New-Business Coöperations Committee.—The industrial power and heating section, new-business coöperations committee of the Ohio Electric Light Association, is to hold a meeting in Columbus, Ohio, on April 23. At the morning session R. T. Kaighin, Cleveland Electric Illuminating Company, is to speak on "Recent Developments of Industrial Heating," and the discussion is to be divided into three sections, "Brass Furnaces," "Low-Temperature Heating," and "Heat-Treating and Melting of Steel." In the afternoon C. J. Crippen, of Youngstown, Ohio, is to have for his subject "Application of Electric Welders and Proper Remuneration for Their Current Consumption."

Jovian League of Kansas City, Mo.—The Jovians celebrated "Mazda Day" on April 3 with a luncheon at the Muehlemach. Boyd F. Gurley, managing editor of the Kansas City *Post*, talked about "Light," and a moving picture was shown, depicting the manufacture of Mazda lamps from the time the ore was mined for the metal and the glass until the finished lamp was produced.

Western Canada Electrical Convention.—Manufacturers, jobbers, dealers, central-station men, contractors and others interested in the electrical industry are to participate in a convention to be held under the auspices of the British Columbia Association of Electrical Contractors and Dealers in Vancouver on May 26 and 27. W. L. Goodwin and Samuel A. Chase are to be among the speakers.

A. A. E., New York Chapter.—The New York Chapter of the American Association of Engineers held a special meeting on the evening of March 28 in New York City. The meeting was addressed by C. E. Drayer, national secretary of the association, his topic being the object of the organization, its sphere of influence and the results already achieved by it. On April 23, at the Engineering Societies Building, Dr. George W. Kirchwey, director of the United States Employment Service, will give an address on "Solving the Unemployment Problem."

American Institute of Electrical Engineers

Rochester Section.—Samuel W. Miller gave a lecture on "The Heat Treatment of Steel" at a recent meeting of the section.

Toronto Section.—"Some Overload Limitations of Current Transformers" will be the subject of W. B. Buchanan, Hydroelectric Laboratories, who is to speak at the April 25 meeting of this section.

Washington Section.—Walter D'Arcy Ryan, head of the illuminating laboratories, General Electric Company, gave a talk on "Illumination" at the meeting held on April 8. The talk was illustrated by over 250 lantern slides and covered ancient and modern lighting, decorative street lighting and the illuminating of the Panama-Pacific Exposition.

Indianapolis-Lafayette Section.—The meeting of this section held on March 4 was a joint one with the Telephone Plant School at Purdue University. Six lectures were given. V. N. Gregg discussed "Systems of Handling and Recording Trouble," Frank X. Staub had for his subject "Maintenance of Central Office Equipment," F. N. Hodgson spoke on "Maintenance of the Outside Plant," H. O. Garman gave a talk on "The Engineering Department of the Public Service Commission," C. A. Breese lectured on "Recent Developments in Central Office Equipment," and H. W. Munsell's subject was "Some Experience in Cutting Over a Large Manual to Automatic Plant."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rate Increases at Stockton.—The Railroad Commission of California has authorized increased rates of charge for both gas and electric service supplied by the Western States Gas & Electric Company, Stockton division. The decision grants increases over surcharges allowed for the duration of the war and establishes the new rates on a permanent basis without surcharge features. This is the third rate increase allowed this company since the start of the war.

Lower Industrial Rates in California.—In a supplemental order issued by the Railroad Commission the Sierra & San Francisco Power Company is authorized to make a reduction in its charges for electric energy served to large industrial consumers. The order substitutes for the surcharge of 3 mills a kilowatt-hour authorized by the commission in a previous decision a graduated scale reading as follows: "Where annual consumption of energy for power purposes is less than 1,000,000 kw.-hr. a year, 3 mills a kilowatt-hour; where the consumption is greater than 1,000,000 kw.-hr. and less than 2,000,000 kw.-hr., 2½ mills; where the consumption is greater than 2,000,000 kw.-hr., 2 mills." The new schedule is provided by the commission in order to give large users of power the benefit of their wholesale consumption.

Improvement in Service.—Authority to increase its present rates for electrical energy by surcharge that will mean an average increase of 20 per cent has been granted the Coast Valley Gas & Electric Company by the Railroad Commission, but the order also carries with it instructions to the company to improve its service. Lack of diligence in this work, says the commission, will bring further action on the part of the board. These improvements will require the expenditure of $25,000 new capital and will consist of the following betterments: Overhauling of steam plant at Monterey, line and transformer improvements at Monterey, rebuilding of Salinas substation and installation of modern switching apparatus, installation of feeder voltage regulators at Monterey and Salinas, and increased substation attendance.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Pan-American Conference.—At a meeting at the Pan-American Building of the governing board of the Pan-American Union, Washington, it was unanimously voted to hold, under the auspices of the union, an informal Pan-American commercial conference in the Pan-American Building during the last week of May or the first week of June of this year. A special committee, consisting of Ygnacio Bonillas, Ambassador of Mexico; Santos A. Dominici, Minister of Venezuela, and Rafael H. Elizalde, Minister of Ecuador, assisted by Director-General John Barrett and Assistant Director Francisco J. Yanes, has been studying the plan and has reported favorably upon it to the full meeting of the board, presided over by Acting Secretary of State Frank L. Polk. The board in turn authorized the Director General to announce the plans for the conference and extend invitations on behalf of the governing board to the commercial and financial experts of the United States government departments, to the consular, commercial and financial representatives of the Latin-American governments in the United States, to the United States Chamber of Commerce, to the National Foreign Trade Council, and to such other responsible commercial and financial organizations, firms and individuals as are interested in the better development of Pan-American trade.

Municipal Ownership Defeated at Alliance, Ohio.—Municipal ownership of an electric plant at Alliance, Ohio, was defeated at an election on April 8, when a proposed four-hundred-thousand-dollar bond issue received a little more than one-third of the votes necessary for passage. The advocates of the issue were headed by the Mayor, and the opposition centered about a citizens' committee, assisted by Glenn Marston. In addition to the activities of the citizens' committee, the employees of the company, both men and women, organized a campaign of their own under the direction of H. G. Bonner, general manager. The ordinance submitting the bond issue to a vote of the people was unanimously passed by the City Council, but two days before the election the councilmen issued a statement advising against voting the bonds on the ground that the time was inopportune and the issue too small to build a complete plant. This statement was signed by every councilman except one, who was too ill to be seen. The statement was issued by the citizens' committee. The company conducted an aggressive publicity campaign during the weeks before the election, showing that the issue had been submitted without securing adequate information as to cost of plant and probable rates to be charged. Motion pictures were used to a considerable extent, a series of animated cartoons being shown.

Increased Operating Costs.—In asking the Public Utilities Commission to revoke its order of July 13, 1917, reducing rates, the Potomac Electric Power Company of Washington, D. C., through William F. Ham, president, shows its increased operating costs. In part Mr. Ham says: "The most important item is coal. When the order previously referred to was entered the commission, among other things, assumed $3.61½ a ton as the price of coal. The average price paid for coal at the Benning plant during the year 1918 was $4.89 per ton and the present price is $5.35 per ton. Also, coal is now of inferior quality to that used prior to the war, greatly adding to the cost of operation and maintenance. The cost of generating energy at the Benning plant is now running approximately 100 per cent higher than at the time the commission's order was issued. Other maintenance costs have also been tremendously increased. Since the beginning of the European war rates of electric light and power companies have very generally increased by authority of regulatory bodies, while this company is only petitioning for the restoration of rates which existed in the period prior to the war."

Oil Price Soars to Great Heights.—The tremendous advance in the price of oil during 1917 is shown in the annual report of the California Railroad Commission. In the chapter dealing with the problems of the public utilities of the state the commission says: "This year (1917-18) has witnessed tremendous increases in the cost of fuel oil. The cost has more than doubled. Formerly the average price varied from 65 cents to 80 cents a barrel, delivered at the companies' plants. Now (1918) the records of the commission show that fuel oil costs $1.62 a barrel in Oakland, $1.86 in Chico, $1.87 in Colusa, $1.65 in Fresno, $1.68 in San Rafael, $1.77 in Marysville, $1.97 in Oroville, $1.68 in Napa, $2.27 in Nevada City, $1.62 in San Francisco, $1.79 in Santa Rosa, $1.762 in San José, $1.77 in Woodland, $1.79 in Vallejo, $1.646 in Santa Cruz, $1.856 in Hollister, $1.60 in Los Angeles, $1.60 in San Diego, $1.55 in Martinez, $1.85 in Yreka, $2.40 in Ukiah, $1.60½ in Stockton, $1.90 in Madera, $2.80 in Needles, $2.52 in El Centro and $1.91 in Modesto." It is estimated that because of lack of rain and snow in the mountains last winter more than 2,000,000 barrels of oil were used by the hydroelectric power companies to produce power, the oil being consumed at their steam plants, which in time of normal rain conditions are held inactive.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Negligence in Leaving Wire Loose.—In action for damages because of the electrocution of plaintiff's husband by contact with a coil of defendant's wire, evidence was held to sustain charges of defendant's negligence in leaving coil without deadheading or grounding a wire and in leaving the wire loose between poles, since it might sag and come in contact with high-voltage wires. (Coverly v. United Water, Gas & Electric Company; 178 P. 393).

Removal of Meters.—A gas company which has installed a gas meter in the cellar of a householder cannot forcibly remove it, against the protest of the householder, without proof that the contract under which the meter was installed gave the company the right to enter the premises and remove the meter, according to the Supreme Court of New Jersey (105 A. 723). A gas meter being in the defendant's possession, the presumption is that it is rightfully so until something is shown which justifies the forcible removal of the meter. The possession may be defended. If the possession of a meter from a householder on whose premises it has been installed by the gas company cannot be regained peaceably, resort should be had to a legal remedy; possession cannot legally be regained by force. The remedy lies in the courts, and the householder is acting within his legal rights in preventing the forcible removal of the meter.

Evidence on Appeal from Commission.—Under Burns' Annual Statutes, 1914, Sec. 10,052, providing that court may hear evidence "different" from and "additional" to that heard by commission, it was proper for the circuit court, on appeal from an order of the Public Service Commission fixing telephone rates, to admit evidence of operating expenses at a time subsequent to the decision of the commission, the Supreme Court of Indiana held (122 N. E. 328). On appeal from order of commission fixing telephone rates, testimony of an expert accountant as to whether cost of operating telephones within the last few years had increased, taking the telephone station as a unit was admissible. Where, on appeal from decision of commission, the circuit court adjudged that decision upon issues tried before commission was wrong, it properly ordered that amount paid by plaintiff into state treasury as expenses of the commission, pursuant to order of commission under the statute cited above, should be repaid to the plaintiff.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

A. T. Early, who has been district manager of the Greenville district for the Southern Illinois Light & Power Company, has been transferred to the Collinsville district.

Henry Bostwick, manager of the San Francisco district of the Pacific Gas & Electric Company, has been elected president of the San Francisco Electrical Development League.

James B. Dugan of Kenton has resigned as chief inspector of the Ohio Public Utilities Commission to become general manager of the Lima district of the Ohio Electric Railway Company.

Glen L. Corey has been appointed district manager for the Pacific Power & Light Company at Seaside, Ore., succeeding A. L. Strickland. Mr. Corey was formerly a solicitor for the company.

A. C. Hopkins has resigned as local superintendent at Belfast, Me., of the Penobscot Bay Electric Company, a subsidiary of the Central Maine Power Company, to enter business for himself. Mr. Hopkins has been in the electric light and power business in Maine and New Brunswick for the past thirty years.

J. S. Pevear of the Birmingham (Ala.) Railway, Light & Power Company has been appointed general manager of the operating department of the American Cities Company. Headquarters of the department are being moved from New York to Birmingham. The American Cities Company, a subsidiary of the United Gas & Electric Corporation, operates utilities in Birmingham, New Orleans, Memphis, Little Rock and other cities.

Philip K. Condict, who has until recently been in government service, has been elected vice-president of the International Western Electric Company, Inc. In the early summer of 1917 Mr. Condict gave up his work as foreign sales manager for the company to take charge of the New York office of the War Trade Board, after a short stay with the Department of Commerce. In December, 1917, he received a commission as major in the Quartermaster's Corps, U. S. A., serving in that capacity until July, 1918. He was then detailed to the Signal Corps with the same rank and served in France until January.

Dr. Frank B. Jewett, chief engineer of the Western Electric Company and late lieutenant-colonel in the Signal Corps, U. S. A., was presented with the distinguished service medal at Washington, on April 5, "for exceptionally meritorious and conspicuous service in connection with the development of the radio-telephone and the development and production of other technical apparatus for the army." Dr. Jewett shortly after the United States entered the war received a commission as major in the Signal Officers' Reserve Corps. His promotion to the rank of lieutenant-colonel followed in the early part of 1918.

Ira Cushing, chairman of the Boston Section of the American Institute of Electrical Engineers, is an ardent worker on behalf of coöperation among engineers of diverse specialties and an active influence in the upbuilding of professional society interconnections in New England. He was born in Brookline, Mass., in 1875 and received the degree of M.E. from Brown University in 1899. Mr. Cushing entered the electrical field in 1901 via the testing department of the General Electric Company in Schenectady, N. Y. After eighteen months' service he was assigned to the department of switchboard design, where he acquired a broad experience in connection with plant layouts and system engineering. In 1906 Mr. Cushing was transferred to the engineering department of the company's Boston office, where he has been identified with switchboard and other consulting work, and during the past two years the technical library of the office has been in his charge. He became secretary of the Boston Section in 1914.

IRA CUSHING

W. J. Canada, who toward the end of 1917 severed his connection with the Bureau of Standards, with which he had been associated for more than four years, to enter the work of the American International Shipbuilding Corporation at Philadelphia, has left this work to join the engineering department of Stone & Webster at New York City. Prior to his association with the Bureau of Standards in Washington, where he was chiefly engaged in the compilation of the National Safety Code, as assistant to Dr. E. B. Rosa, Mr. Canada was for some time electrical engineer with the insurance interests in the Rocky Mountain section of the country.

J. F. Derge, for the past six years superintendent of lighting plant sales of the Utah Power & Light Company, Salt Lake City, has been promoted to be sales superintendent in charge of all sales work. Prior to going to Utah Mr. Derge was manager of the commercial department of the Missoula (Mont.) Light & Water Company.

Thomas W. Peters, who for the last twelve years has been commercial agent of the Columbus (Ga.) Electric Company, has resigned to become associated with the Chero-Cola Company of Columbus. Mr. Peters was one of the founders of the Southeastern Section of the National Electric Light Association, of which he was the first president and later secretary.

J. G. Holtzclaw has been appointed to succeed T. J. Hanlon, Jr., as manager of the Pensacola (Fla.) Electric Company. Mr. Holtzclaw is a native of Georgia and a graduate of the electrical engineering department of the Georgia School of Technology, class of 1907. He has been general superintendent of the local company for the last three years and has been connected with the company in various capacities for eight years. His experience with the Stone & Webster interests embraced three years with the Savannah Electric Company before going to Pensacola as manager of the Pensacola property.

Obituary

Frank Carter Childs, president of the Nightingale & Childs Company, Boston, dealers in asbestos material, died recently at Lexington, Mass. He was educated at the Massachusetts Institute of Technology and was well known in the power-plant field.

Alexander Cochrane, identified for many years with the development of the telephone through his service on the directorate of the American Telephone & Telegraph and allied companies since their organization, died suddenly in his home in Boston on April 10 at the age of seventy-nine years.

Edwin J. Mullen, former general manager of the Philadelphia office of the General Electric Company, died at his home in Germantown, Pa., on April 5. Mr. Mullen was born Nov. 4, 1838, and had been prominently identified with the electrical industry for thirty-five years. He was general manager of the Thomson-Houston Company when the merger resulting in the present General Electric Company took place. He retired from active work as head of the Philadelphia office Jan. 1, 1916, but during his retirement had acted in an advisory capacity and was in the office almost daily.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

EASTERN SECOND-HAND MARKET SHOWS INCREASED ACTIVITY

Reputable Business Dealing Puts Market on Sound Basis—Stocks Ample—Prices About 75 per Cent of New

Among the dealers in second-hand apparatus established in and near New York City are found both those whose trade is mostly local and those who do a country-wide business. Inquiries among the former show that there is considerable business at the present time in small numbers of rather small-capacity motors, both direct-current and alternating-current types.

The preponderance of direct current still holding on Manhattan Island leads to more business in equipment with characteristics for that service, but the alternating-current service is gaining ground, and in sections outside of the borough of Manhattan there is considerable sale for alternating-current apparatus.

The size of the units is in general rather small, usually for additional equipment to small operators or where a small business is being started. The number of instances of installations of such a character where second-hand equipment is being used is large.

Outside of New York City there seems to be considerable call for used equipment, many times running into large sizes of motors. It is found that manufacturers who have been unable to fill orders from stock have called on used-equipment dealers to supply the required apparatus.

This brings to attention the class of work turned out by reputable dealers in used apparatus. So many dealers are securing business on the basis of service they see to it that every article of equipment is thoroughly repaired and tested, commutators turned down and bearings replaced if necessary, the machine painted in its original color before it leaves the shop, and a guarantee given against mechanical and electrical defects for one year. In such cases the machines have virtually been rebuilt.

Prices of this machinery, which at times during the war were equal to or above the prices of new equipment, have come down to the neighborhood of 60 to 75 per cent of new machinery prices. Stocks gathered during the latter part of the past year by dealers were so large that the decline in business which was evident the first of this year found them generally overstocked. Recently, however, resumption of business has begun to move these stocks, but not to the point where there is any great amount of buying for restocking.

The anticipated flooding of the second-hand market with electrical equipment from factories which had ceased their war work has not materialized. The government in some cases is turning back to contractors as part payment motors which that contractor still may use, and in other cases is keeping motors for use in some of its own work. And there are many instances where dealers will not bid on lots offered by contractors and the government on account of their already large stocks. Prices around $5 per horsepower are being offered for some lots of motors. Many of the pieces of apparatus have never been uncrated. There is, however, much apparatus that has been severely damaged by acid fumes, chemicals and overload.

There has been reported a satisfactory market for steam generating sets in practically every section of the country but the New York section. This equipment ranges from boilers to distribution panels.

With electrical equipment repaired, if necessary, tested and given the same guarantee as is given by the manufacturer, with prices now in the neighborhood of 25 per cent less than new, there is a very active field for second-hand dealers. There is in general sufficient central-station power available to supply normal commercial needs. More confidence is being placed in second-hand material as a result of reputable business methods on the part of so many of the dealers.

Although there has not been as much used material thrown back on the market as was at one time anticipated, there has recently been released a quantity of boilers in the East and Middle West. These comprise 130 boilers, aggregating approximately 57,000 boiler-hp. One hundred of the boilers have been in service less than four years.

STANDARD PACKAGES FOR ELECTRICAL HEATING DEVICES

A Movement Put on Foot Some Months Ago Appears to Be Gaining Considerable Headway with Appliance Manufacturers

Several years ago electrical jobbers began to study the cost of handling orders for single irons, single toasters, single percolators and other devices of this character in connection with their general studies of the evils of the small-order business. These studies brought out that a very large percentage of the appliance orders amounted to less than $10 and were expensive for the jobber to handle on that account. Accordingly, some method of reducing the expense of handling this business was thought to be necessary.

This search for a method led to the adoption of the standard-package idea as one which might bring a solution. When this stage in the development was reached the jobbers put the proposition up to the manufacturers. Already one manufacturing company has begun to pack certain items in standard packages. The following table will show the trend of developments in that line:

Devices:	Number for Standard Package
6-lb. flat-irons	12
Toasters	12
Toaster stoves	6
Round table stoves	6
Curling irons	4
Warming pads	4
Headlight heaters	3
Small immersion heaters	4
All other appliances	6
Combination package	6

These are the standard-package quantities adopted by this particular manufacturer. This manufacturer has also gone further and has called three standard packages a standard quantity. In order to give the dealer who orders in quantity the advantage of this plan a discount schedule has also been arranged so that there is about 10 per cent difference between the price which the dealer pays for a single flat-iron and the price he pays for it if he buys it in a standard package. There is a further differential of 10 per cent between the standard package and the standard quantity. Distributers who are operating under this plan state that it is working out very well, but they express a belief that it will work out much better when other manufacturers shall have put their distribution on a standard-package basis.

The tendency seems to be for other manufacturers to get into this scheme of distribution at an early date. The whole proposition is regarded by them as a problem in education. It will first be necessary to fix a standard package which will be satisfactory to the majority of manufacturers. All manufacturers are not in accord with those quantities adopted by the manufacturer above referred to. The discussion is over the dozen and decimal plans of packing. When this stage has been passed certain of the manufacturers believe that it will be wise first to adopt a standard-package method of selling and educate the dealers to buy in standard packages without making any price concessions. This, they argue, will give the smaller dealer an opportunity to learn about the system before it is thrust upon him. After this educational campaign, lasting over a few months, has been completed, then it is probable that a discount plan will be arranged which will give the large buyer the advantage of making quantity purchases.

METAL MARKET CONDITIONS

Copper and Lead Both Decline in Price—Market Very Dull

There has been another turn in the copper and lead markets. Prime Lake has declined ¼ cent, to 15.50 cents; electrolytic has dropped ¼ cent, to 15.37½ cents, and casting copper is off 0.3 cent, to 15 cents a pound. Buying has dropped off appreciably, even where some dealers are shading prices more than the ¼ cent quoted by the larger interests.

The London spot market is nearly £3 lower than a week ago, and British commercial interests have almost withdrawn from the market. British stocks of copper apparently are being absorbed, as the amount in the hands of that government on April 1 was 2671 tons less than on March 1. Previous months had shown an increase.

Lead is down ¼ cent, to 5 cents a pound, but the reduction has proved no stimulation to buying. Advices from Washington state that the disposition of surplus government stocks of lead is being made at local market prices at points where the surpluses are being held. As this amounts to only 7000 tons, it is not expected that its sale in small lots will have any appreciable effect on the market.

Tin and spelter sales have been noticeable by their absence. Conditions of the steel market have not materially changed during the last few days, and there is little buying.

The scrap-metal market reflects the new metal market in regard to its quiet state, but heavy lead is the only scrap suffering a material drop. There is no buying anyway. Aluminum scraps seem to enjoy the only movement, but the supply is short.

NEW YORK METAL MARKET PRICES

	April 8	April 15
Copper:	£ s d	£ s d
London, standard spot	79 0 0	76 10 0
	Cents per Pound	Cents per Pound
Prime Lake	16.00	15.50
Electrolytic	15.50	15 37½
Casting	15.30	15.00
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.00
Antimony	6.80	6.75
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.52½	6.50
Tin	Govt. price 72.50	Govt. price 7.25
Aluminum, 98 to 99 per cent	30.00	30.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 13.75	13.50 to 13.75
Brass, heavy	7.50 to 8.00	7.50 to 8.00
Brass, light	6.50 to 7.00	6.50 to 7.00
Lead, heavy	4.25 to 4.50	4.00 to 4.25
Zinc, old scrap	4.25 to 4.75	4.25 to 4.75

THE WEEK
IN TRADE

SALES of wiring material and socket devices are going along well. Stocks are still being kept down by jobbers, but are being built up by manufacturers.

Building is increasing, particularly in the Middle West. A large amount is being held up until something definite comes out of the steel price situation.

Prices are still receding here and there, some apparatus prices falling this week.

NEW YORK

Conditions among jobbers point to a better state of business than in the previous months of the year. There are increasing demands for wiring devices, and these seem to be to a large extent for residential purposes. Apparatus which can be applied to already existing circuits is showing its continued strong market. Business in general is such that jobbers show their optimism over what the coming months have in store for them. Although buying for stocks, as it is normally considered, is light, jobbers are keeping their stocks abreast of conditions as they expect them in the near future. With the rather quick deliveries which manufacturers can in general make, the jobbers feel that it is not so necessary to carry the amount of stock previously required.

As to labor shortages and surpluses, reports received by the United States Employment Service from sixty-six cities record an increase in surplus labor from thirty-eight cities for the week ended April 5. There is a shortage in nine and an equality in nineteen cities. These figures take in the representative employers of the cities enumerated and merely show the trend of the labor situation in those localities.

SCHEDULE MATERIAL.—Jobbers report an increase in sales. The consumption seems to be for the most part for residential work.

DRY CELLS.—The increasing commercial uses for which dry cells of the large type and for flashlights have been adapted are keeping a steady market for this product.

TRANSFORMERS.—Power transformers of 200 kva. rating and above have been reported off another 10 per cent as of the first week in April. The former reduction was the middle of February. There is a fair movement of this material in the South and Southwest.

CEDAR POLES.—An increased activity has been noted this past week due to several carload shipments to the Middle West. This is in conjunction with pole-line material for power work previously reported.

ELECTRIC FURNACES.—There is some activity in this material and a great deal pending the resumption of the output of steel products.

SEWING-MACHINE MOTORS.—There is considerable activity among garment manufacturers. Conditions of drive are being changed, and motors for both individual and group drive, the latter especially low-speed motors, are finding a strong market.

LAMP CORD.—Large orders continue to come in, particularly from lighting fixture and apparatus manufacturers. This also is producing a good market for sockets and attachment material.

CONDUIT.—Orders for pipe are gradually opening up, but a considerable call is noticeable for flexible metallic conduit.

LIGHTNING ARRESTERS.—The market continues strong for both power and railway-type arresters.

WIRE.—Bases quoted by manufacturers of rubber-covered wire have not changed this past week. Seven producers

quote 20 cents. Lamp cord is quoted on an 18-cent base and weatherproof on 19 cents.

MOTORS.—The demand is improving for motors of a smaller size for industrial work, along with their control equipment and switchboards.

BOSTON

Sales are being maintained in good volume, with highly diversified business. Contractors are getting more active and house-wiring campaigns have been started at Providence, R. I., and Manchester, N. H. At Quincy, Mass., 234 houses are to be completed within about three months for shipyard workers. The Quincy central station expects to spend $40,000 this year on extensions, and the Boston Edison company has somewhat relaxed the restrictions it has hitherto maintained on electric-range services. General building is below normal still.

Jobbers' stocks are still fairly large. One large Boston house reports increased sales and volume of material handled for the first quarter of 1919 compared with a year ago. Price reductions have been announced on irons and radiators and single-phase motors. Deliveries are improving and few are now quoted in excess of seven weeks for usual jobbing material. Collections are somewhat improved this week. A shortage is reported in certain makes of vacuum cleaners and in armored conductor. The strike that began on Tuesday morning of telephone operators and allied electrical workers all over New England was the most threatening feature of the labor situation at the time of writing.

WIRE.—Bare and weatherproof wire have stiffened a little in price this week, the base quotations being respectively 18½ cents and 20 cents. Rubber-covered wire is steady at 22 cents base. An increasing demand is noted, and deliveries are in good shape. Many repair jobs are being handled by the contracting houses. The supply of armored flexible conductor is somewhat under normal.

MOTORS.—The demand for small motors appears well sustained. A 10 per cent reduction in Century single-phase motors was announced last Saturday. Polyphase motors hold firm in price. A good deal of factory-drive betterment work is under way, and the New England Power Company is making a campaign to raise the power factor in many industrial installations on its lines through the readaptation of motors to loads.

CONDUIT.—Prices rule about as last week. The supply is coming into New England pretty much as needed, deliveries being excellent. Should building operations take a sudden boom through the belief that present costs of labor and material will be long sustained, it is likely that the supply of conduit would soon be exhausted and that strenuous work would be necessary to maintain present delivery rates.

FANS.—Jobbers are ready to supply the trade in case of a demand for fans, but as yet retail buying is at a minimum. Many dealers are carrying fans from their 1918 stocks. It is probable that in some central-station circles fans will be sold this year on the installment plan to stimulate business which might otherwise be retarded by upward price tendencies.

WIRING MATERIAL.—Stocks are in good shape to meet eventualities, as the diplomats sometimes term an attack in force. Present purchases are for repair work and for new construction on a moderate scale only, or for public or semi-public structures in the main.

WASHING MACHINES.—The demand is remarkably well sustained, and stocks are being refilled at a rate which insures exceedingly prompt deliveries.

VACUUM CLEANERS.—Trade is very brisk and prices are firm. A decided shortage is reported this week in two prominent lines. A fine spring business is now being handled.

PORTABLE LAMPS.—Despite daylight saving, trade is fairly good. The return of service men to the colleges has developed considerable business in study lamps which under normal conditions would have been handled in the fall. One Boston house is making a hit by utilizing army helmets in indirect-lighting fixtures. Floor lamps continue to be popular.

ELECTRIC RANGES.—The outlook is improving. Last week the Boston Edison company sold six ranges, and a prominent dealer is reported to have sold two carloads. Easier conditions are being accorded to range service installations in some cases.

CHICAGO

The beginning of the long-heralded spring construction program is now definitely in sight. Not only does this apply to the construction of buildings and public works within the city of Chicago, but it also applies to central-station construction work throughout the Middle Western territory. In Chicago's best building year, 1916, the average weekly total of building permits was $1,585,000. The average over a five-year period before the war taken for the first three months of the year was $1,183,000 per week. After running along at a low figure for the early part of the year, the total of weekly building permits recently reached a peak of $1,450,000 and attained another peak this week which totaled $2,509,000.

Jobbers report that business is coming along in good shape and that line extensions from 1 mile to 30 miles long are affording numerous inquiries.

COPPER WIRE.—The market strengthened just a trifle this week on account of the large number of inquiries for wire to supply line-extension demands. The base on weather-proof and rubber-covered copper wire is between 19 and 20 cents.

CONDUIT SPECIALTIES.—Business in this line is beginning to pick up with the opening of building construction. There have been no reductions in prices, but this was not a deterring influence on buying since prices in this line were not raised to unreasonable figures when the advances were made.

DOMESTIC APPLIANCES.—There has been no general decrease in prices of electrical appliances, and manufacturers have informed jobbers that no decrease need be expected for some time to come. The American Electric Heater Company has begun to distribute its appliances in standard packages and standard quantities, making a differential of about 10 per cent between the price of one item and the standard package and another differential of 10 per cent between a standard package and a standard quantity. Six electric irons will constitute a standard package and thirty will constitute a standard quantity.

IRON WIRE.—The prices of iron wire and steel-stranded wire are off somewhat. The price of steel strand has decreased 10 per cent, while the price of iron wire has decreased about 5 per cent.

LIGHTING FIXTURES.—Manufacturers of lighting fixtures claim that the farm-lighting plant sales are the biggest factors in building up the demand for fixtures in the present market.

REFRIGERATING MACHINES.—One manufacturer in Chicago proceeding with this type of equipment for domestic use is closing contracts for distributing his machines along lines used by automobile companies. He is granting exclusive contracts to distributers in certain territories, giving them authority to appoint sub-agents.

WIRELESS TELEGRAPH.—Within thirty days one manufacturer expects to have wireless-telegraph sets on the market. He expects to distribute these through the electrical trade.

ATLANTA

The percentage of textile machinery idle through the increase of mill orders and the adjustment of labor controversies is diminishing—but encouraging indications such as this are modified by the reduced activities at iron and steel establishments. Briefly summarizing the electrical field, it may be said that wholesale and jobbing trade has been well maintained and buying seems to be more confi-

dent, retail trade has enlarged slightly and ordinary collections are good. The million-dollar development of the Blue Ridge Power Company, Tuxedo, N. C., is progressing rapidly and 44,000-volt transmission lines will be constructed to Tryon and Saluda, N. C.; Spartanburg, Inman, Campobello and Landrum, S. C.

CABLE.—The heavier sizes from 500,000 circ. mil. to 2,000,000 circ. mil. went back to a 20-cent base after the sag in prices of last week. A brisk movement is noted and orders are increasing. Slow-burning weatherproof is especially active. A number of large industrial establishments that have caught up on orders are taking this opportunity to rehabilitate certain departments badly in need of maintainance. Factory shipments are promised for thirty days.

RANGES.—Selling activity on the part of distributers appears to be lagging temporarily, and transactions have fallen off accordingly. While a fair volume of business is being done, it is not up to the standard set for this period of the year. Deliveries are much improved.

INSULATORS.—There has been no price change in the past fifteen days. Glass insulators are in greater demand than for some time, the business coming from small central stations and industrial extensions. The call for the porcelain type has shown signs of revival, and spotty requirements point to the fact that activity is increasing; but nothing big is expected for a little time at least, as the greater portion of orders sustaining this item come from large developments and maintenance projects which are being delayed. Factory shipments are good.

POLES.—Producers and distributers report an increasing demand. This week's business is especially active. An analysis of orders received fails to show that any one branch of the industry is more active than another. A healthy condition exists and future prospects look bright. Sales for the first quarter of 1919 are well ahead of the same period in 1918. The large Western stocks are being slowly distributed, and deliveries from local stocks are excellent. The looked-for drop in prices has not appeared.

HARDWARE.—The call has quickened considerably in sympathy with the increased movement in poles; but the volume of transactions dropped to such a low level following the armistice that a substantial demand will have to exist before this item will reach anywhere near the point that may be called good. Prices are gradually dropping, a slight decline being registered this week. The average shipments have been reduced to two weeks.

LAMP CORD.—The advent of warm weather this week increased the local call for considerable quantities of lamp cord, anticipating the rush of fan-motor requirements. Local stocks are ample. Prices are steady.

FANS.—Outside of a small flurry during the early part of this week, no perceptible movement is noted locally. The southernmost sections, however, are now entering a period of semi-summer temperature, and central stocks have been called upon to fill these requirements. Shipments from Eastern points are much improved over the same period of last season, and stocks are being well maintained. Fan stocks in general are well distributed this year, and dealers and jobbers have the stage set to take care of a larger business than ever before handled.

SEATTLE—PORTLAND

Both jobbers and dealers in Seattle report business during the past week on a par with activities of several weeks past. From all appearances shipyard owners intend to know their ground regarding cancellation of old contracts, receipt of new contracts and policy of government in respect to foreign contracts before purchasing in excess of actual demands. Heavy equipment, such as motors, transformers, generators and the like, is not moving.

Inquiries from out-of-town central stations are pouring in regarding prices for equipment for proposed improvements and extensions, but orders have not materialized. An authoritative source in Seattle states that if inquiries on hand developed into orders and if central stations which have plans prepared for extensions and additions would proceed, Northwest jobbers would be swamped with new business.

Jobbers' sales to out-of-town dealers during the past week showed a slight increase over the past three weeks, although the increase is not considered indicative of immediate future increases. Some of the smaller towns in northern, central and southwestern Washington report an exceptional increase in amount of residence construction. The larger cities, particularly Tacoma and Seattle, are also having slight increases in the number of building permits, although actual spring building has not started. Eastern Washington territory reports a heavy demand for pumping machinery for irrigation purposes. New tracts of land are being brought under water and new plants installed to replace those which have outlived their usefulness. Mines in the Spokane and Cœur d'Alene districts are showing increasing activity. This is especially true of smaller producers and new concerns. Sales of mining equipment, including motors both large and small in considerable volume, are noted. Labor conditions in the Pacific Northwest are considerably improved, although the scarcity of farm labor is still causing anxiety.

In Portland business conditions remain unchanged as compared with last week. Many plans are being prepared, but there have been no steps to date toward putting them into execution.

Farm-lighting plant sales during the past week showed a slight increase in sales, comparatively well divided over territory served by the Spokane, Wallawalla, Seattle and Portland districts. House-wiring device sales during latter part of the week increased noticeably. Jobbers have a good supply of wire, lighting fixtures, bells, etc., on hand. Prices remain steady.

SAN FRANCISCO

Practically ideal weather conditions for farmers, orchardists and vineyardists have obtained this season. The rice industry is increasing enormously, new mills being built to take the valley crops and new wharves to handle overseas shipments. The United States government has decided to increase by at least 50 per cent the capacity of the Mare Island Navy Yard because of the intention to keep half of the battleship fleet in the Pacific Ocean. New docks, new ways and new equipment for scraping and painting will be installed and the personnel of the yard considerably increased. The respective building permits for the month of March were: San Francisco, $910,000; Los Angeles, $1,122,000; Oakland, $495,000. Interior cities are running about two-thirds of their 1918 showing for the same month.

Collections are fair, with an increased tendency to extend longer terms of payment, due to the preponderance of large devices, requiring term payments, in the dealers' purchases.

MOTORS.—Business for this year, though brisk, cannot compare with that of last year, because of the greater amount of rain this season, nor are there so many new industrial plants to be equipped. Motors this season are sold through education and sales effort rather than a demand on the customer's initiative.

WASHING MACHINES.—The most popular electrical device at the present time is the washing machine, of which all sizes and varieties are cropping up to take advantage of this condition. Prices are still steady.

LAMPS.—Demands are lower than for last year, when the government industrial business was in full swing. Stocks are good and well distributed. The especial feature of this season is the remarkably keen competition for dealers' accounts.

RUBBER-COVERED WIRE.—Large circular-mil cable has again decreased, taking a 2½ per cent fall. Stocks are good and demand small.

MARINE MATERIAL.—A new schedule of prices laying especial stress upon quantities is reported. The United States business for emergency fleet ships has naturally decreased, but the activity of local commercial bodies for export trade is boosting the business of local manufacturers.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	20%
Coil to 1000 ft	25%
	No. 12 Solid
Less than coil	20%
Coil to 1000 ft	25%

Twin-Conductor

	No. 14 Solid
Less than coil	20%
Coil to 1000 ft	25%
	No. 12 Solid
Less than coil	20%
Coil to 1000 ft	25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	40	.40—.41
50 to barrel	.35—.36	.36—.37
Barrel lots	.32—.329	.33—.339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
3/8	250	$5.00
1/2	250	7.50
3/4	100	10.00
1	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
1/2-in. single trip	$75.00	$63.75— 69.75
1/2-in. double strip	75.00— 82.50	72.00— 75.00
3/4-in. single strip	100.00	85.00— 93.00
3/4-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
1/2-in. single strip	$75.00	$63.25 to $63.75
1/2-in. double strip	78.25 to $78.75	71.25
3/4-in. single strip	100.00	75.00 to 85.00
3/4-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
3/8	$0.05 1/2	1	$0.25
1/2	.06	1 1/4	.33
3/4	.09	1 1/2	.40
3/4	.12	1 3/4	.47
1	.15	2	.55
1	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$25.00	$18.00	$16.00
1/2-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$60.00	$30.00	$26.00–26.50
1/2-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	7% to 12.1%	9% to 14.1%
2500 to 5000 lb.	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 to 1/2 In.	3/4 to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.18
Coil to 1000 ft.	25.94

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft.	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–30%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $17.00
1/5 to std. pkg.	12.00 to 14.00
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$22.00
1/5 to std. pkg.	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39
No. 18, full spools	.37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$24.00
25 to 50 lb.	24.00
50 to 100 lb.	23.00

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$23.75 to $35.75
25 to 50 lb.	23.75 to 34.75
50 to 100 lb.	23.75 to 37.35

NEW APPARATUS & APPLIANCES

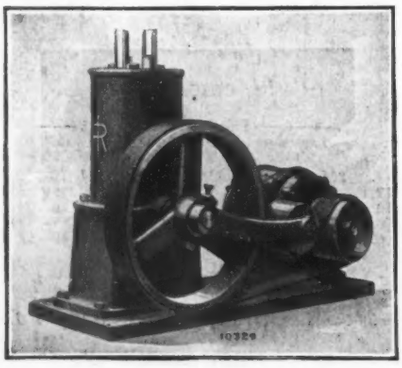
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Converting Helmet Into Lighting Fixture

Military helmets which the soldiers bring home may be made both ornamental and utilitarian by converting them into indirect lighting fixtures for illuminating small rooms through the use of fittings procurable from the National X-ray Reflector Company, 233 West Jackson Boulevard, Chicago. This equipment, which includes a canopy complete with an insulating joint and a fiber ring, three suspending chains finished in the color of the helmet, an interior lining for the helmet, and a small X-ray reflector for 100-watt or 150-watt lamps, is known as No. 3921-D.

Small Single-Acting Air Compressors

In designing its type "Imperial Fourteen" small air compressors it was the desire of the Ingersoll-Rand Company, 11 Broadway, New York City, to obtain good efficiency of operation with the close secondary consideration of general ruggedness and simplicity. Features of their construction are the drop-forged crank shaft, the die-cast renewable bearings and the automatic splash lubrication system. There are four sizes of these compressors with ratings of from 3 cu.ft. to 45 cu.ft. (0.08 cu.m. to 1.3 cu.m.) per minute at pressures to 100 lb. per square inch (7 kg. per sq.cm.). However, they can be used for pressure requirements up to 200 lb. per square inch (14 kg. per sq.cm.) if the driving power is slightly



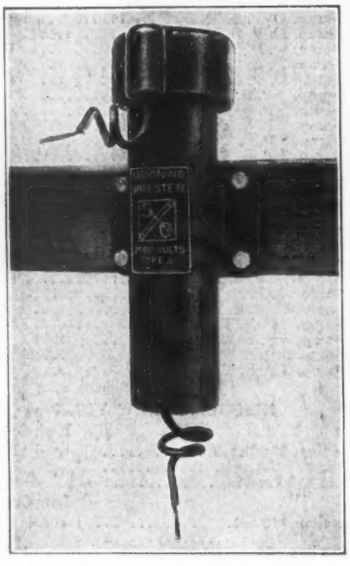
ADDITIONAL BASE FOR MOTOR MOUNTING

increased. The units can be furnished complete with individual motor mounted upon a hardwood base plate or prepared to be driven from line shafting.

The smallest size of these compressors is built with a ribbed cylinder for air cooling where service is intermittent and with a water-cooled cylinder of the reservoir type for continuous operation

Multi-Chamber Lightning Arrester

For service on 2500-volt distribution systems Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, have developed a multi-chamber lightning arrester, which consists of a number of discharge gaps connected in series with a resistance and mounted in a porcelain tube closed at both ends excepting for a ventilating hole at the lower end. The mounting bracket of this arrester, which is known as type



HAS FIVE SERIES GAPS IN SEPARATE CHAMBERS

"L," is an integral part of the main housing and may be secured to either cross-arm or wall.

The operating element of the arrester comprises five series gaps, each gap mounted in a separate cylindrical chamber. These cylindrical chambers are open only at one end, and the discharge gap in each chamber is placed near the closed end.

When a discharge passes through the arrester the heated air back of each gap in the closed ends of the respective chambers blows the arc out toward the open end of the chamber. This blow-out action is said to be very effective in extinguishing the arc and in rupturing the dynamic current that tends to follow the high-voltage discharge. The insulating blocks are assembled so that the path between adjacent gaps is a maximum.

Adjustable Lamp Clusters for Portable Lamps

The adjustable lamp cluster just developed by the Peerless Light Company, Halsted, Adams and Green

ESPECIALLY SERVICEABLE WITH FLOOR-STAND PORTABLE LAMPS

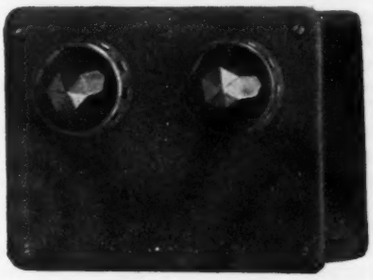
Streets, Chicago, fits not only one or two particular shades but can, the maker points out, be used with any type or shape of portable lamp shade. It is also claimed that because of the swivel adjustment incorporated in the clusters the sockets can be adjusted to obtain the utmost efficiency from the lamp bulbs under all conditions. These clusters are made with the "E-Z" wire stem, which makes for ease in assembly and wiring.

Safety Steel-Inclosed Switches

Ability to withstand hard usage is one of the chief claims made for the safety switch—one which can be placed in any position—being marketed by the Leonard Electric Manufacturing Company of Cleveland, Ohio. The door of the cabinet cannot be opened without tripping the switch, therefore making it impossible to re-fuse a live switch. In addition, the switch cannot be partly closed and left in that position, because of an arrangement which causes the switch to "fly" open when it is not fully closed. This prevents insufficient contact and subsequent heating of the switch parts and eliminates arcing at the contacts on opening the circuit. The lever and toggle principle is embodied in the handle, and an easy pull will close the switch, while a slight blow suffices to open it.

Signal Box with Non-Interchangeable Lenses

Where exposed colored bulbs are used for pilot lamps in switching installations they are easily damaged, and in renewing them an operator may accidentally place a green bulb in the socket intended for a red one and thereby defeat the purpose of the indicating signals, which is to tell whether the respective disconnecting switches are



RED AND GREEN LENSES WHICH CANNOT BE INTERCHANGED ARE USED

open or closed and to protect the operator when inspecting or repairing the circuit breaker. To remove such disadvantages the Lewis & Roth Corporation of Philadelphia has brought out a signal box for switch structures in which white bulbs are installed behind red and green lenses and a barrier placed between the bulbs prevents one lamp from illuminating both lenses. The two lenses are set in the hinged cover of the box in such a way that interchanging them is impossible. In order to identify the circuits a name plate may be affixed to the front of the box.

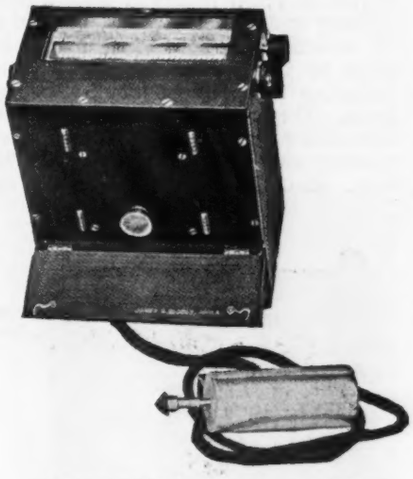
Combination Electric Waffle Baker, Griddle and Toaster

A recent addition to the line of cooking apparatus made by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City, is a combined electric griddle, toaster and waffle baker. It is constructed throughout of heavy wrought steel bound and braced with polished steel trimmings mounted on an angle-iron frame with an undershelf. The griddle top is 27 in. (68 cm.) long and 16 in. (40 cm.) wide, made of polished steel, is heated by the same units that heat the waffle irons, and can be used separately or in connection with any of the other two operations.

The toasting or baking compartment is 23 in. (58 cm.) wide and 13 in. (33 cm.) deep inside. Heat is supplied by both top and bottom units, separately controlled by three heat switches. Bread is toasted on both sides at the same time, saving considerable time over other methods. Three wafflle irons, each holding two cakes, rest on an angle-iron frame which can be removed when the fixture is used for toasting, three bread-toasting frames being furnished for this purpose. A removable drip pan is also supplied for cleaning, etc. This cooking device operates on 110-220 volts, has a total connected load of 6 kw. and weighs 200 lb. (90.7 kg.).

Multiple-Scale Speed Indicator

Designed to measure the entire range of commercial speeds up to about 12,000 r.p.m. with as high a degree of accuracy as the Frahm vibrating-reed tachometer, the Frahm "electro-tachometer" or revolution indicator has recently been developed by James G. Biddle, 1211 Arch Street, Philadelphia. It is said that this high degree of accuracy is maintained for practically an indefinite period and is well defined throughout the different ranges. The instrument possesses considerable advantages over the ordinary-type tachometers with speed indicators, which so frequently need inspection and calibration and the indications of which are always open to doubt, the maker states. A characteristic feature of this



UNIDIRECTIONAL IMPULSES UTILIZED

instrument which recommends its use as a universal speed-testing instrument, particularly in testing several electric motors or generators, is that the whole set can be observed at the same time. Speeding up or slowing down the machine is shown instantaneously by this device as well as any irregular behavior, thus enabling the attentive observer to form a good idea of the character and working of the machine.

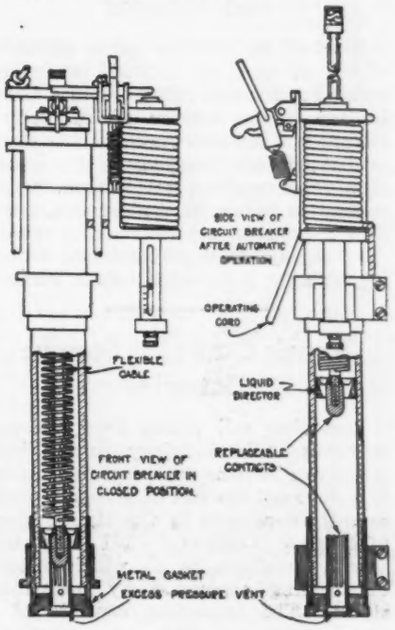
The electro-tachometer, so called to distinguish it from the regular vibrating-reed tachometer as well as from the centrifugal type, consists of a set of reeds excited in the same way as the frequency meter by means of electromagnets whose action is assisted by a permanent magnet. Instead of alternating current, however, unidirectional impulses are utilized. A multiple-scale arrangement is provided for, which permits one to read five single scales, for instance 2000 to 5000, 1000 to 2500, 500 to 1250, 250 to 625, 200 to 500. Similar scales down to 100 and up to 12,000 can be obtained without difficulty.

High-Voltage Automatic Circuit Breaker

A small, compact, high-voltage circuit breaker with contacts operating in a non-inflammable liquid similar in some respects to carbon-tetrachloride has been developed by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago. The switch element itself for 33,000 volts is only 36 in. (91 cm.) high by 4 in. (10 cm.) wide by 4 in. deep without the mounting when in the open position. With the mounting it measures 82 in. (208 cm.) high by 24 in. (60 cm.) deep by 8 in. (20 cm.) wide. The switch consists of a moving contact mounted on the end of a spring-actuated operating rod and a stationary contact mounted in the base of the breaker. The current is conveyed to the moving contact through flexible copper connections so that the current carried through the spring is negligible.

Mounted on the end of the operating rod and next to the moving contact is a liquid director—a funnel-shaped arrangement—that forces a powerful stream of the liquid into the moving contact as it recedes through the liquid when opening. Immediately under the stationary contact is an excess-pressure vent which opens when the pressure in the main tube becomes abnormally high due to the rupturing of very heavy short circuits. This vent, as well as the two main contacts, is easily replaced.

The operating rod which carries the moving contact extends out through the top of the circuit breaker and is provided with a cross-bar to which the

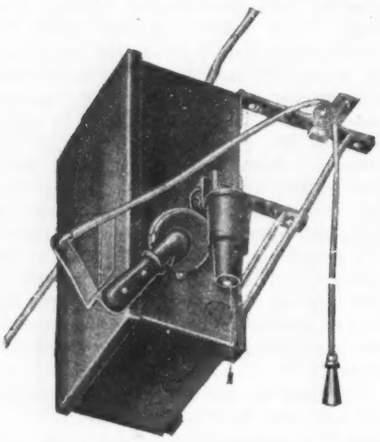


NON-INFLAMMABLE LIQUID ALSO ACTS AS A FIRE EXTINGUISHER

operating mechanism is attached. Mounted on top of the circuit breaker is a series relay which provides the automatic overload feature of the device.

Ceiling Mounting for Motor-Starting Switches

Where the motor-starting switches with undervoltage release coils made by the Trumbull Electric Manufacturing Company, Plainville, Conn., are to be installed high above the operators' heads they can be obtained with ceiling brackets and with operating cords. One of the cords works over a pulley so that the switch mechanism can be easily operated from the floor. Another cord connects with the undervoltage release coil and is pulled to throw the switch into the "off" position.



SWITCH EASILY OPERATED FROM THE FLOOR

Completely Inclosed Washer and Wringer

That all its working parts, exclusive of the wringer, are inclosed in a white enamel and nickel cabinet with a table-lid top is the feature of an electric clothes washer announced by the Bluebird Appliance Company of St. Louis, Mo. The washing mechanism, which is said to be simple and strong, operates a polished copper rocking cradle. A large adjustable power-driven swinging wringer is mounted on the washer.

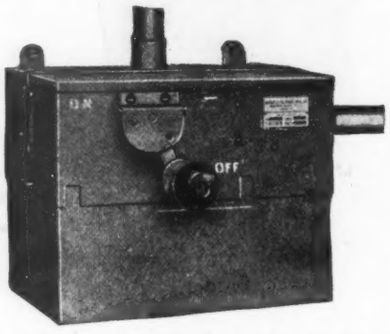
Repair Outfit for Storage Batteries

Removing cell plates from storage batteries without injury to the batteries can be done with ease and quickness through the use of a repair outfit recently developed by the Hauck Manufacturing Company, 101 Eleventh Street, Brooklyn, N. Y., which softens the sealing compound by means of steam. The apparatus consists of a steam generator with six jets, three of which are controlled by a valve. The valve is closed for three-cell batteries and opened when all six jets are used. Sufficient steam can be obtained in from two to three minutes. The steam generator is fitted with a safety pop valve which blows off at pressures of 10 lb. per square inch (700 g. per sq.cm.). However, the manufacturer claims pressure is never needed above 3 lb. per sq.ft. (200 g. per sq.cm.). The process of softening the battery's sealing compound is very simple, the vent caps being removed, the jets inserted on each cell and steam forced directly into the cells. Within four or five minutes the plates are removed. Grease and other impurities can be steamed and cleaned off the batteries at the same time.

The outfit is operated by kerosene, although when desired gas burners can be furnished. A 1-gal. (3.7-l.) capacity kettle to melt wax for resealing, a 35-lb. (15-kg.) capacity melting pot for reclaiming lead and a mold to make lead sticks are furnished with the apparatus.

Fused Oil Switches Having Automatic Attachments

For a number of uses, particularly as entrance switches, oil disconnecting switches and for the control and protection of small induction motors and lighting and power circuits, type N-2 oil switches are now being manufactured by the Condit Electrical Manufacturing Company of South Boston, Mass. They are suitable for use with alternating-current motors where the starting current does not exceed 100 amp. at 220 volts or less, or 60 amp. at 440 or 550 volts; also for use as service switches, oil disconnecting switches and similar applications, where the current does not exceed 60 amp. at pressures of 600 volts or less. These switches are made in two, three and four poles, single-throw type, in non-automatic form, with and without fuse clips. Under-voltage or shunt-trip attachments are furnished with either form.



FUSE CHAMBER AND OIL TANK MAY BE LOCKED INDEPENDENTLY OF EACH OTHER

All live parts and mechanism of the switches are entirely inclosed. The switch may be locked in open position, and the fuse chamber may be closed independently of the oil tank and vice versa. Fuses are dead when the switch is open, while the position of switch contacts is plainly indicated. The circuit is opened under oil and a high factor in insulation is present. Inclosed fuses afford overload and shunt-circuit protection. On reduction or loss of voltage the undervoltage attachment automatically disconnects the circuit, and with the shunt-trip attachment the circuit is allowed to be opened from a remote point.

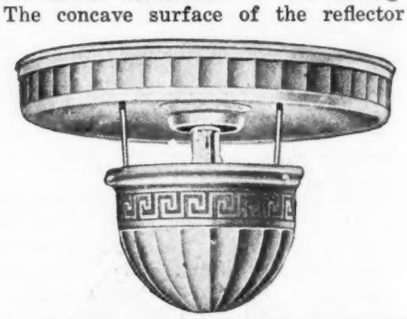
Electric Frying Kettles

For frying food quickly the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City, has developed electric kettles. They are made of heavy polished cold-rolled steel and are insulated on the bottom. A three-heat switch for 110 volts or an off-and-on switch for 220 volts is furnished with kettles and is intended for mounting on a side wall. The kettles are equipped with a wire drainer basket and holder. Four sizes of the kettles may be obtained, the smallest having dimensions of 14 in. by 7 in. (35 cm. by 18 cm.) and the largest 24 in. by 10 cm. (61 cm. by 25 cm.). The minimum and maximum wattages of the smallest of the four kettles are 562 and 2250, while those of the largest are 1125 and 4500.

Lighting Fixtures for Gas-Filled Lamps

For illuminating stores, offices or public buildings "Lightolier" No. 3802 has been brought out by the Lightolier Company of 569 Broadway, New York City. It is adapted for gas-filled lamps up to and including 200 watts and is said to give a maximum of properly toned light. Both the reflector and the bowl are of translucent glass embossed in Grecian design. This unit is intended for rooms with low ceilings or where it is desirable to have the light source at a considerable distance from the working place. Fittings are supplied for attaching the fixture directly to the ceiling. The over-all length of the fixture is 36 in. (91 cm.), the reflector is 16 in. (40 cm.) in diameter and 2½ in. (6 cm.) deep, while the diffusing bowl has a 6-in. (15-cm.) diameter and is 9 in. (22 cm.) deep.

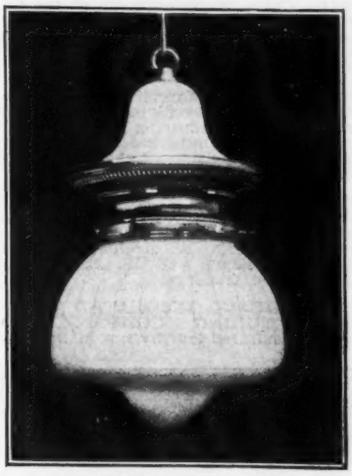
This company has also developed design No. 3653, which is identical with the fixture described above except that a canopy and chains replace the fittings for direct attachment to the ceiling. The concave surface of the reflector has been designed to direct the light down to the plane of usefulness but permits sufficient light to filter through and break up unsightly ceiling shadows.



FURNISHED BOTH IN CHAIN TYPE AND FOR DIRECT CEILING ATTACHMENT

Commerical Lighting Fixture for Stores and Offices

The combination of an artistic design with good efficiency is the main feature of a commercial lighting unit recently placed on the market by the

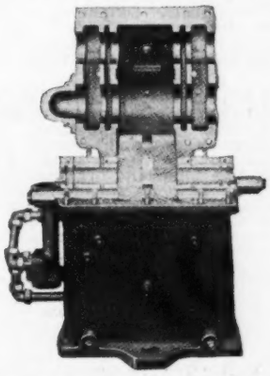


WELL-VENTILATED, BUG-PROOF AND DUST-PROOF

General Gas Light Company, 50 West Broadway, New York City. This well-ventilated and bug-proof fixture, known as the "Humphrey Radio 30," has a self-centering spring globe holder with a porcelain enameled dome. When the metal parts of the fixture are finished in antique brass a green porcelain enameled dome is supplied, and when they are finished in nickel a white porcelain dome is furnished. The length of the unit is 38 in. (91 cm.) from the top of the canopy to the bottom of the globe.

Strongly Constructed Speed Reduction Gears

Although intended primarily for use with Terry turbines, the reduction gears illustrated, made by the Terry Steam Turbine Company of Hartford, Conn., are available alone whenever desired. A well-ribbed, double-walled, boxlike structure, extending the full



COVERING REMOVED SHOWING GEARS

depth of the case, forms a rigid support for each pair of bearings of these gears. The space between the walls acts as a water jacket for cooling the oil, and the ribs between the walls serve as both stiffening members and water baffles. The central part of the case, directly under the gears, forms an oil reservoir which contains sufficient oil to supply not only the gears but also the turbine. This construction of the case also insures accurately maintained alignment of the gears.

The bearings are of ample size, insuring safe pressures and rubbing speeds, and are split horizontally to permit replacement without removing the couplings. The lining used is of high-grade tin-base babbitt on both gear and pinion. Interchangeability of the bearings makes it possible, in case of excessive wear, to replace them easily and quickly and restore the original alignment.

In spite of the cool operation of the gears, a water-cooling system forms part of the standard equipment. The gears may be furnished for either direction of rotation, the only change being location of the oil-spray piping above or below the contact point.

Portable Meter for Illumination Intensities

One of the most difficult problems in obtaining correct illumination in industrial plants is occasioned by the lack

MEASURES ILLUMINATION IN FOOT-CANDLES WHEN PLACED ON DESK OR WALL

of an instrument for telling whether or not adequate lighting is provided. The inspectors who visit the plants are not usually electrical engineers and therefore cannot enforce rules if they cannot tell what is needed. Moreover, contractors installing equipment do not usually know whether the correct intensity exists in the industrial plant. Recently, however, a light, compact and easily operated foot-candle meter has been developed which is being distributed by the "Mazda" interests—that is, the Edison and National Lamp Works of the General Electric Company, at Harrison, N. J., and Cleveland, Ohio, respectively, and the Westinghouse Lamp Works, 165 Broadway, New York. The instrument, which was designed by Dr. Clayton H. Sharp, Electrical Testing Laboratories, consists mainly of a screen, lamp bulb and flashlight cell, voltmeter and rheostat, all contained in a leather case.

The lamp bulb is arranged at one end of the compartment illustrated here, having a screen which consists of a clear-glass plate, a sheet of thin paper and opaque paper, with a series of holes on one side, the opposite side sloping toward the bulb.

When the correct voltage is applied to the lamp, as indicated by the mark on the voltmeter, the intensity of the light being measured is indicated at the point on the scale where the spots are invisible in comparison with the screen background.

NOTES ON RECENT APPLIANCES

Induction Motors

A line of induction motors is being manufactured by the Electric Machinery Company, Minneapolis, Minn.

Soldering Iron

A special garage repair soldering iron with three tips is being made by the Dover Manufacturing Company, Dover, Ohio.

Motor-Driven Oven

The Crandall-Pettee Company, Beach and Hudson Streets, New York City, is making a motor-operated gas oven of the reel type for bakeries.

Dish-Washing Machine

The Couch Dean Corporation of Hartford, Conn., has improved its model CD-3 "Autosan" motor-driven dishwasher for restaurants and hotels.

Key and Keyless Porcelain Sockets

Additions to the line of sockets made by the Connecticut Electric & Manufacturing Company, Bridgeport, Conn., are key and keyless porcelain types having 600-watt, 250-volt mechanisms.

Portable Electric Heater

A portable electric heater having a rating of 660 watts and built for use on both 110-volt and 220-volt circuits is now being made by the Despatch Manufacturing Company of Minneapolis.

Electrically Operated Dishwashers

Electrically operated dishwashers with capacities of from 3000 to 15,000 dishes per hour and suitable for hotels and restaurants are being sold by F. G. Street & Company, 60 Broadway, New York City.

Mixing and Beating Machine

To mix dough, whip cream and beat batter and eggs and to perform other culinary operations the "Reliance Mixobeater" has been developed by the American Mixing & Beating Machine Company, 72 Liberty Street, Brooklyn, N. Y.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Norway (No. 28,970) desires to purchase and secure an agency for the sale of electric touring cars (without tops), Edison batteries preferred.

A man in Belgium (No. 28,930) desires to secure an agency for the sale of all kinds of electrical supplies and material. Correspondence may be in English.

A man in Italy (No. 28,928) wishes to secure an agency for the sale of electrical materials and machinery. Payment guaranteed through bank deposit. Correspondence should be in Italian.

A merchant in France (No. 28,918) desires to purchase and secure an agency for the sale of all sorts of electrical appliances and apparatus, such as motors, heaters, lighting fixtures and tools. Terms of payment, cash against documents. Correspondence should be in Frecnh.

A man in Italy (No. 28,897) desires to receive an exclusive agency for the sale of electrical machinery, magnetic sheet steel, batteries, frequency meters, phasometers, current meters, instruments of precision, electric apparatus for mines, for chemical industries and for electric railways; also insulating material, mica paper, varnish, fiber and cable insulators, medical applications, marine installations, magnetos, telephone apparatus and telephone switchboards. Correspondence may be in English.

Westinghouse Changes

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces through the *Westinghouse Electric News* these changes in its personnel:

R. L. WILSON has been appointed general superintendent of the electrical work. Mr. Wilson studied mechanical engineering at the University of Iowa and at Rose Polytechnic Institute and electrical engineering at Johns Hopkins University. After an apprenticeship of one year with the General Electric Company he became associated with the Westinghouse company as draftsman, later as engineer, then erection engineer, superintendent of construction, and at the time of his promotion he was superintendent of the railway department and assistant general superintendent of the electric works.

GEORGE H. COX, former manager of the supply division, Boston office, has been appointed district manager of that office. S. St. J. Morgan, manager of the Boston office, has become president of the Lamson & Hubbard Company, Boston and Canada, retail and wholesale fur dealers.

B. H. CHATTO, of the small-motor section, engineering department, has been appointed to a position in the industrial department where his duties will be in connection with power and light plants for agricultural districts.

F. A. BERG has been promoted to be manager of the condenser section of the power department.

CAPT. N. H. CALLARD, who has been discharged from government service is appointed to the railway sales department in the capacity of commercial engineer.

E. O. GALYON has been discharged from the service and is transferred to the company's St. Louis service department as superintendent of the electrical division.

W. KEITH McAFEE has been transferred to the service department as railway engineer.

F. D. KENNEDY is appointed superintendent of the railway department of the works.

C. D. LAMADE has taken up his duties as superintendent of ratings and inspections at the Krantz Manufacturing Company's plant at Brooklyn, N. Y. Mr. Lamade has been in the inspection department since 1905, and before going to the Krantz plant he was in charge of inspection work in sections E, O & P and at Trafford City.

ELECTRICAL GOODS NEEDED IN SWEDEN.—Sweden's needs, especially in view of the growth of new war industries and the increased purchasing power of the people, should be studied, says the British Consul General at Gothenburg. Electric lamps, fuses, switches, etc., also electric motors were almost exclusively imported from Germany before the war. The electrical industry, which was strongly established in Sweden, has taken the opportunity afforded by the limitation of German production to extend its borders. The extension of industrial activity has greatly increased the demand for mechanical and electrical appliances of all kinds. Thus electrical power is being increasingly supplied to all industrial concerns, and will eventually be extended to many of the railways. All sources of water power in Sweden have recently passed into the control of the state, and such power will in future be fully utilized. This has created a great demand for electric fittings and appliances of all kinds.

LINCOLN ELECTRIC CONTINUES WELDING SCHOOL.—The Lincoln Electric Company, Cleveland, Ohio, is continuing as a permanent peace-time institution the school in electric welding established by the Emergency Fleet Corporation. No tuition fee is charged, and the course is open to all who wish to take it. An instructor is provided, and a small lecture room and twelve welding booths are completely equipped. The purpose is to train employees of purchasers in the use of the apparatus and also to provide expert welders for manufacturers who may need their services.

BOOTHS IN LINCOLN ELECTRIC WELDING SCHOOL

NEW POSITION OF NORWAY IN LAMP MARKET.—Attention has recently been called in the Norwegian press to the change in the lamp position in Norway since the establishment of the first factory for manufacturing lamps in that country. It is only two years since the A-S Norsk Elektrisk Lampefabrick started business at Dranmen, but the rapid increase in the demands made upon the firm has necessitated new buildings and extensions. These are now completed, and the previous output of 4600 lamps per day will be largely increased. Previous to the war most electric lamps were imported to Norway from Germany. The present position seems to indicate that Norway will soon supply her own needs and enter the field of exporters.

THE RAILWAY & POWER EQUIPMENT COMPANY, Woolworth Building, New York City, reports that it is planning increased scope of operation. With this in mind it has been incorporated in Delaware with a capital stock of $5,000,000, $3,000,000 common, $2,000,000 7 per cent cumulative preferred. In addition to the interests of Charles F. Johnson, who has been carrying on the business for about twenty years, it has taken in other interests. Its new work is planned to include engineering and equipment work in any way connected with power, railroads, industrial establishments and contracting in all parts of the world. The company announces export inquiries for electric power and lighting machinery for Japan, derricks and electrical machinery for China, electric motors for Bombay, India.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, announces the discontinuance of its office at Wichita, Kan. F. V. Sargent has been appointed district manager of sales in the Boston territory, succeeding F. S. Eggleston, with headquarters at 182 High Street, Boston.

THE VULCAN STEEL PRODUCTS COMPANY, INC., and the Vulcan Trading Corporation, general exporters and importers, are occupying new general offices at 136 Liberty Street, New York City.

LANDERS, FRARY & CLARK, New Britain, Conn., manufacturers of the "Universal" line of electric heating goods, it is reported, will build a four-story factory building, 60 ft. by 162 ft., at Plainville, Conn.

B. H. AHLERS, formerly sales manager of the circuit-breaker division of the Condit Electrical Manufacturing Company, has since March 1 taken up sales work with the insulated-wire division of the Marlin-Rockwell Corporation, New Haven, Conn.

THE ARCHIABLE ELECTRIC COMPANY, 138 West Third Street, Cincinnati, incorporated February, 1919, is now operating with George W. Archiable as president and manager and W. E. Retsch as secretary and treasurer.

THE CHICAGO INSULATED WIRE & MANUFACTURING COMPANY, Sycamore, Ill., suffered loss by fire in the neighborhood of $150,000. Several buildings and some stock were damaged. The plant was one of the largest in the Central West for the manufacture of insulated copper wire.

THE CONSOLIDATED BELTING COMPANY is now located in the plant formerly occupied by the Biddle Motor Car Company at Germantown and Sedgley Avenues, Philadelphia, where it has greatly increased facilities. The former location of the company was Chester, Pa.

CAPT. A. L. MULLERGREN, Construction Division, U. S. A., has received his discharge from the service and has returned to his duties as secretary and treasurer of the Benham Engineering Company, consulting engineers, Oklahoma City, Okla. Captain Mullergren was officer in charge of steam heating and assistant to the constructing quartermaster at Camp Funston, Kan.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, announces that Charles W. Unbehaun, formerly New York City and general Eastern salesman for the Bailey-Drake Company, Chicago, has joined its organization in the capacity of branch manager. Mr. Unbehaun will cover Eastern New York and the state of Connecticut with portable electric drills, electric air compressors and electric valve grinders.

IRVING SAMUELS has established offices in the Hunsicker Building, Allentown, Pa., as an electrical and mechanical sales engineer and manufacturers' agent. Mr. Samuels is a graduate of Lehigh University and served as efficiency engineer for the Lehigh Valley Transit Company, Allentown, Pa., in 1913; became engineer in charge of distribution for the Lehigh Valley Light & Power Company, also in Allentown, in 1914, and in July, 1918, resigned to accept a position as electrical engineer for the Air Nitrates Corporation in New York City in connection with the design and construction of the government nitrate plants at Toledo and Cincinnati, Ohio, and at Muscle Shoals, Ala. While with the Lehigh Valley

Light & Power Company, Mr. Samuels served as chairman of the local section of the National Electric Light Association and also was chairman of the company's safety committee.

THE HOWE SPECIALTY COMPANY, Cleveland, Ohio, has let contracts for a factory building to cost $70,000.

THE RECIPROCATING ELECTRIC TOOL COMPANY, Louisville, Ky., has increased its capital from $10,000 to $100,000.

THE MITCHELL-RAND MANUFACTURING COMPANY, 99 John Street, New York City, has removed to larger quarters at 18 Vesey Street.

THE ALLIED ENGINEERING COMPANY, INC., has removed from 546 Fifth Avenue to larger quarters at 1400 Broadway, New York City.

THE KING MANUFACTURING COMPANY, St. Joseph, Mo., is successor to the King Foundry Company, manufacturer of street-lighting equipment.

THE INDEPENDENT LAMP & WIRE COMPANY, York, Pa., manufacturer of wire products, will build a one-story addition at a cost of $6,500.

THE MECHANICAL APPLIANCE COMPANY, motor manufacturer, announces that its Chicago office after May 1 will be in Room 545, Webster Building, 327 South La Salle Street.

THE DELTA ELECTRIC COMPANY, Marion, Ind., has plans for a large addition to its plant for the manufacture of dry-cell batteries. The factory will have a capacity of 15,000 batteries daily.

JOHN N. WATSON, accountant, has become associated with Colonel Rogers Birnie, A. S. M. E., and Major Wilford J. Hawkins, A. S. M. E., consulting engineers and accountants, 511 Fifth Avenue, New York.

WILLIAM GARTNER, manager of the New York salesroom of the Bell Electric Motor Company, 30 Church Street, New York City, has returned to civil duties. He has just been discharged from the service in which he acted as electrician at Texas aviation field.

THE PRECISION INSTRUMENT COMPANY, Detroit, Mich., announces the addition of William L. DeBaufre to its corps of engineers. Mr. DeBaufre was formerly in the same department with the navy at Annapolis, which position he resigned to become associated with the Precision Instrument Company.

THE EFFICIENT SERVICE COMPANY, 1966 Broadway, New York City, is representative for New York State for A. F. Daum, Pittsburgh, Pa., manufacturer of renewable fuses and Eastern representative of the Automatic Electrical Devices Company, Cincinnati, Ohio, manufacturer of battery-charging and control apparatus.

CAPT. A. C. NELL, construction division, United States Army, who has been in charge of the purchase of power and mechanical equipment in the construction division, has been released from service and appointed Chicago district manager for the Lea-Courtenay Company and the Schutte & Koerting Company, with offices at 1466 Conway Building. Mr. Nell was formerly with the Allis-Chalmers Manufacturing Company.

L. K. COMSTOCK & COMPANY, New York City, constructing engineers, announce the establishment of a new department known as the electrical equipment department under the direction of W. J. Moore. This department will engage in the sale of complete industrial and power equipments. It has been organized for the purpose of offering a more inclusive and continuous service to clients in connection with the purchase and installation of equipment required for new plants, extensions and maintenance.

THE STANDARD REFRACTORIES COMPANY, Claysburg, Pa., manufacturer of silica brick and other refractories, recently issued $500,000 ten-year 6 per cent first mortgage bonds for the purpose of refunding a small bond issue now outstanding, also for permanently funding additions made to the plant during the war period, to purchase a ganister property which the company is now operating and to add to the plant a complete machine shop and warehouse. It is not the intention of proceeding at once, however, with the building of the new machine shop and warehouse, but this will likely be done later this year.

Trade Publications

FARM-LIGHTING PLANT.—The L. A. Young Industries, Inc., Detroit, Mich., has got out a folder about its "Lay" farm-lighting plant.

WASHING MACHINES. — The Globe Manufacturing Company, Perry, Iowa, has issued a colored window poster showing nine illustrations of its machines.

ELECTRIC TRUCKS.—"E. S. E." electric trucks are the subject of a folder recently issued by the West Motor Company, Twentieth Street and Avenue B, New York City.

FUSES.—The Bussman Manufacturing Company of St. Louis has issued a booklet telling about its renewable and non-renewable cartridge fuses, fuse plugs, fuse links and fuse wire.

CIGAR LIGHTER.—In a recently issued mailing card the Electric Sales Corporation, 1812 Ninth Avenue South, Seattle, Wash., gives some of the advantages of its electric cigar lighter.

RENEWABLE FUSES.—The National ferrule and knife-blade-type renewable fuses are listed in a folder prepared by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago.

FUSES.—The D & W Fuse Company, Providence, R. I., describes its cartridge-type renewable fuses in catalog No. 16 and its knife-blade-type renewable fuses, with jacketed fuse link, in a supplement to the above catalog.

TOOL GRINDERS.—New bench and floor type electric tool grinders are covered in a leaflet being distributed by the Janette Manufacturing Company, Singer Building, New York City, and 617 West Jackson Boulevard, Chicago.

GLASS REFLECTORS.—The Gleason-Tiebout Glass Company, 99 Commercial Street, Brooklyn, N. Y., is issuing a new series of bulletins. Bulletins 1 and 2 of the series are about blown-glass reflectors and English line reflectors.

OIL MOTOR STARTERS.—Type G-1 oil motor starters with maximums of 100 amp. and 600 volts are fully described in illustrated bulletin No. 436, being described by the Condit Electrical Manufacturing Company, South Boston, Mass.

COMBINATION WASHER AND DRYER.—The Marlow Manufacturing Company, 2152 Superior Avenue, Cleveland, Ohio, describes its new electric clothes washer and dryer for combination or separate use in a leaflet of recent issuance.

BATTERY-CHARGING RHEOSTATS.—Bulletin No. 27 has been prepared by the Electric Products Company of Cleveland, Ohio, to supersede bulletin No. 26 and to cover its battery-charging rheostats for trucks, tractors and locomotives.

WATER-BOTTLE HEATER AND CURLING IRON.—The Christian Heater Sales Company, 532 Grand River Avenue, Detroit, has got out an illustrated leaflet describing its combination electric curling iron and hot-water-bottle heater.

POWER-FACTOR SURVEYS.—In a recent issue of the "Esterline Graphic," published by the Esterline Company of Indianapolis, Ind., the subject of power-factor surveys with relations to the instruments made by this company is taken up.

LIGHTING FIXTURE.—"More Light on Your Profits" is the title of an attractive mailing folder being distributed by the Miller Saw-Trimmer Company, Point Building, Pittsburgh, Pa., to tell about its "Anyangl," adjustable industrial lighting fixture.

THERMOCOUPLE PYROMETERS. — Causes of and methods of prevention of errors in pyrometer equipment are brought out and discussed in bulletin No. 867-B, issued by the Leeds & Northrup Company of 4901 Stenton Avenue, Philadelphia, entitled "Checking Thermocouple Pyrometers." It discusses the importance of maintaining standards and of checking in pyrometry and points out sources of error and the remedies for troubles in thermocouples, millivoltmeters, cold junctions and potentiometers.

FLASHLIGHT DISPLAY AND STOCK CABINET.—The "Niagara-Lite sales winner" is described in a leaflet prepared by A. Hall Berry, 71 Murray Street, New York City.

DIRECT - CURRENT GENERATING SETS.—Catalog No. 103 of Engberg's Electric and Mechanical Works, St. Joseph, Mich., will shortly be available. It is thirty-two pages long and describes in detail the improved direct-current generating sets made by this company in 1-kw. to 50-kw. sizes.

STEAM-JET AIR PUMPS.—Preliminary Bulletin No. 113, illustrating and describing the Wheeler steam-jet air pump, is now being distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J. This pump, which is applicable to jet condensers as well as to surface condensers, features two or more steam jets working in series with a condenser between the jets. The bulletin explains operating principles, describes the inter-condenser and shows an operating test curve. It includes a cross-section drawing and shows how to connect double machines or triple machines to surface condensers.

New Incorporations

THE SMITHLAND (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $8,000 by H. Wilson, G. L. Crawford, M. L. Poell and others.

THE ELECTRICAL CONSTRUCTION COMPANY of Charlotte, N. C., has been incorporated with a capital stock of $100,000 by G. S. Harrison, G. R. Trotter and C. E. Barber, all of Charlotte.

THE RURAL RETREAT (VA.) POWER COMPANY has been incorporated with a capital stock of $25,000 to supply electricity in Rural Retreat. J. S. Etter is president, and C. W. Davis is secretary.

THE ELECTRIC VACUUM CLEANER COMPANY of New York, N. Y., has been incorporated by J. Sherwin, G. E. Patterson and A. K. Baylor, 120 Broadway. The company is capitalized at $50,000.

THE DEVON ELECTRIC COMPANY of Pittsburgh, Pa., has been incorporated by W. I. Bickford and associates. The company is capitalized at $50,000 and proposes to manufacture electrical specialties.

THE BATTERY & ELECTRIC SERVICE COMPANY of New York, N. Y., has been incorporated with a capital stock of $25,000 by C. Alexander Lion. The company proposes to manufacture electric storage batteries.

THE HASKELL ELECTRIC COMPANY of Holyoke, Mass., has been incorporated by Frank E. Haskell, F. Haskell and R. L. Davenport. The company is capitalized at $30,000 and proposes to manufacture electrical supplies.

THE UNITED STATES ELECTRIC MANUFACTURING CORPORATION of New York, N. Y., has been chartered with a capital stock of $50,000 by J. J. Lazroe, A. Caming and G. Frankel, 666 West 162d Street, New York City.

THE LIBERTY STORAGE BATTERY COMPANY of Wilmington, Del., has been incorporated with a capital stock of $502,000 to manufacture electric storage batteries. The incorporators are C. Heilig and E. V. Fulton of Wilmington.

THE RENFREW (ONT.) ELECTRIC PRODUCTS, LTD., has been incorporated by Stephen H. Murphy, John A. Jamieson, Thomas A. Low and others. The company is capitalized at $500,000 and proposes to take over the property and business of the Renfrew Electric Manufacturing Company.

THE A. M. CASTLE ENGINEERING COMPANY of Toronto, Ont., has been incorporated by Walter G. Hammond, 24 King Street, West; Jacob H. Greenberg, John D. Bradford and others. The company is capitalized at $275,000 and proposes to manufacture gas and steam engines, electric generators and other machinery.

New England States

CLAREMONT, N. H.—The Claremont Power Company is contemplating the installation of a new electric generating unit with auxiliary equipment.

SPRINGFIELD, VT.—Plans are under consideration by the Springfield Brass Company for the installation of a new electrically operated furnace at its foundry for brass casting work. Energy for operating the company's works is supplied by the Colonial Light & Power Company of Cavendish.

CAMBRIDGE, MASS.—Plans are being prepared by the New England Telephone & Telegraph Company for an addition to its exchange building on Inman Street.

WARREN, MASS.—A boiler house and new pumping plant will be erected in connection with the new addition to the plant of the Warren Steam Pump Company.

WORCESTER, MASS.—The Worcester Pressed Steel Company is contemplating the erection of an addition to its rolling mill, 90 ft. by 150 ft., to be equipped with electrically operated machinery.

Middle Atlantic States

BINGHAMTON, N. Y.—The Nineteen Hundred Washer Company is planning to equip all the departments of its works for electrical operation. Electricity will be furnished by the Binghamton Light, Heat & Power Company.

BUFFALO, N. Y.—The finance committee of the Board of Supervisors, it is understood, is considering the installation of lighting, heating and ventilating plants in connection with the proposed county home and hospital.

BUFFALO, N. Y.—Extensive alterations and improvements to the municipal pumping station, including the installation of new equipment, are under consideration by the City Council. A bond issue of $136,000, it is said, will be authorized for the work.

BUFFALO, N. Y.—Application has been made to the City Council by Acting Chief M. W. Koester, Great Lakes Communication Service, for permission to erect two steel radio towers, about 200 ft. high, at the foot of Michigan Avenue, in connection with the establishment of a new government radio station for Great Lakes communication.

LONG ISLAND CITY, N. Y.—Loft, Inc., has awarded general contract to John H. Carl for a factory addition, 155 ft. by 200 ft., five stories, on Vernon Avenue, between Dayton and Hamilton Streets. A large garage will be erected in connection with the project. The cost of the buildings is estimated at about $500,000. The company manufactures candy and operates a chain of confectionery stores. Tenney & Ohmes are engineers.

LONG ISLAND CITY, N. Y.—Considerable electric equipment, including motors, light and power wiring, and auxiliary electrical apparatus with pumping apparatus for fire service, will be required in connection with the new manufacturing plant to be erected by the American Chicle Company, 19 West Forty-fourth Street, New York, to be located on Nott Avenue, Long Island City. The cost of the building is estimated at over $1,000,000.

NEWARK, N. Y.—Bids will be received by Mrs. Sarah F. S. Armstrong, president of board of trustees, State Custodial Asylum for Feeble-Minded Women, Newark, N. Y., until May 8 for construction, including heating, sanitary and electrical work for cottage for inmates, at the State Custodial Asylum for Feeble-Minded. Drawings and specifications and blank forms of proposals may be consulted at the above asylum, at the New York office of the Department of Architecture, Room 1715, Tribune Building, and at the Department of Architecture, Capitol, Albany. L. F. Pilcher, Capitol, Albany, is state architect.

NEW YORK, N. Y.—The United Electric Light & Power Company has begun work on the erection of a new transformer station at 201st Street and the Harlem River. The building will cost about $16,000.

NEW YORK, N. Y.—The Wappler Electric Manufacturing Company, 173 East Eighty-seventh Street, is considering the construction of a plant on Harris Avenue, Long Island City, where it proposes to locate its main plant. The company manufactures X-ray equipment, etc.

NEW YORK, N. Y.—Auerbach & Sons, candy manufacturers, have awarded general contract to Marc Eidlitz & Son for the erection of an eleven-story addition, 100 ft. by 200 ft., to their plant at Eleventh Avenue and Forty-sixth Street, to cost about $500,000. Tenney & Ohmes are engineers.

NEWARK, N. J.—The Town Council of Hillside is considering extension to the street-lighting system.

NEWARK, N. J.—Preparations are being made by the Lowenstein Radio Company, 50 Spring Street, for alterations and improvements to its plant.

NEWARK, N. J.—Plans have been filed by the Spitdorf Electrical Company, 98 Warren Street, for alterations and improvements in a section of its plant.

NEWARK, N. J.—Bids will be received until April 21 by George C. Bergen, purchasing agent, for furnishing a supply of incandescent lamps for the several county institutions during the coming year.

PEMBERTON, N. J.—The Browns (N. J.) Electric Light Company, recently organized, is contemplating extending its system to Pemberton. A franchise has been granted the company by the Board of Freeholders to erect electric transmission lines along the county road.

COATESVILLE, PA.—Notice has been filed by the Chester Valley Electric Company with the Public Service Commission of an issue of $82,000 in bonds. Part of the proceeds, it is understood, will be used for extensions to its system.

SCRANTON, PA.—The Carleton Coal Company is planning to rebuild its coal breaker at Minooka, which was recently destroyed by fire, causing a loss of about $50,000. The plant was driven by electricity.

WILMINGTON, DEL.—The power plant of the Wilmington & Philadelphia Traction Company was recently damaged by fire, causing a loss of about $10,000.

BALTIMORE, MD.—Samuel T. Williams, 223 North Calvert Street, Baltimore, would like to receive prices on power-plant equipment, including a 250-kw. to 300-kw. generator and engine, directly connected, 250 volts, direct current; directly connected compound engine, and also condenser and air pump, boiler pressure 100 lb., switchboard, instruments, etc.

MILLVILLE, W. VA.—Contract has been awarded by the Northern Virgina Power Company to the Consolidated Engineering Company, Calvert Building, Baltimore, Md., for the erection of an addition to its local electric plant.

MOUNDSVILLE, W. VA.—Plans are under consideration by the C. McKinley Company for the installation of electrically operated machinery to replace steam-driven equipment in connection with the rebuilding of its coal tipple recently destroyed by fire.

HARRISONBURG, VA.—Contract has been awarded by the city of Harrisonburg to Betts & Boice to construct a concrete dam at the municipal hydroelectric plant. The cost is estimated at about $40,000. N. Wilson Davis of Harrisonburg is engineer in charge.

RURAL RETREAT, VA.—The Rural Retreat Power Company, recently organized with a capital stock of $25,000, proposes to supply electricity in Rural Retreat. The company will purchase energy from the Appalachian Power Company of Bluefield, W. Va. J. S. Etter is president.

North Central States

DETROIT, MICH.—The construction of an electric railway from Flint to Davison and Potter's Lake, with continuation to Elba, Lapeer and Imlay, is reported to be under consideration by the Detroit United Railway.

DETROIT, MICH.—Contract has been awarded by the Stecker Electric & Machine Company, 34 Bates Street, for the construction of a factory building, to cost about $135,000, to W. S. Pocock & Company, Hammond Building.

HOWELL, MICH.—The Detroit Edison Company has purchased a site in Howell on which it proposes to erect a distributing station, to cost about $25,000. The company recently purchased the municipal electric plant.

MARQUETTE, MICH.—The Commissioners have authorized bids to be called for the construction of a new municipal electric light plant. It is proposed to send blank forms for bids to a number of contractors. The new plant will be located about one-quarter of a mile below the present plant. Charles Retallic is manager of the municipal electric plant.

TUSCOLA, MICH.—An election will soon be called to submit to the voters the proposal to grant a franchise to the Frauhenmuth Light & Power Company to install an electric lighting system in Tuscola.

CLEVELAND, OHIO.—Plans are under consideration by the Aluminum Castings Company, 2800 Howard Avenue, Cleveland, for the erection of a power house on Harvard Avenue and East Twenty-eighth Street, to cost about $50,000. The G. S. Rider Company, Century Building, is architect.

WASHINGTON, IND.—The City Council has petitioned the Public Service Commission for authority to issue $20,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant.

LIMA, OHIO.—The Lima Electric Railway & Light Company, it is reported is contemplating the construction of a large power plant in Lima. The company is controlled by the Ohio Electric Railway Company of Springfield.

MOUNT UNION, OHIO.—The installation of a municipal electric light plant in Mount Union is under consideration.

WOOSTER, OHIO.—Bids are being asked by H. H. Miller, service director, for lighting the streets of the city. The construction of a municipal electric light plant in Wooster is under consideration.

GHENT, KY.—The Ghent Electric Light Company, recently organized with a capital stock of $5,000, has been granted a franchise to install an electric lighting system.

SMITHLAND, KY.—Contract has been awarded by the Smithland Light & Power Company to the Home Electric & Supply Company of Paducah, at $8,000.

ATTICA, IND.—The Indiana Public Service Commission has granted the Attica Electric Light Company permission to issue $10,000 in bonds to complete its new electric plant.

COLFAX, IND.—The Colfax Electric Company, recently organized, is planning to supply electricity in Colfax. George Davis is interested in the company.

LINN GROVE, IND.—The Commissioners of Wells County have granted the Linn Grove Light & Power Company a franchise to erect an electric transmission line from Riverside to Craigvile, to supply electricity in the latter town and to residents along the line.

LOGANSPORT, IND.—Plans are under consideration by the city officials for the installation of ornamental lamps from College Hill to Spencer Park.

MARION, IND.—The Delta Eletric Company is planning to erect a large addition to its Marion plant for the manufacture of dry cell batteries.

MONMOUTH (R. F. D. from Decatur) IND.—A company is being organized, to be known as the Monmouth Light & Power Company, to furnish electricity for lamps and motors in Monmouth.

SHELBYVILLE, IND.—A company is being organized to utilize the water power of Flat Rock River at St. Paul. The engineers recommend the construction of a dam 280 ft. long across the top and 35 ft. high.

UNIONDALE, IND.—The Commissioners of Wells County have authorized the Union Township Electric Company to erect an electric transmission line from Uniondale to Prospect to enable it to secure energy from the Fort Wayne & Northern Indiana Traction Company.

WINAMAC, IND.—The Winona Telephone Company is contemplating improvements to its system, to cost about $12,500. W. E. Daniels of Knox, Ind., is secretary.

BLOOMINGTON, ILL.—The construction of a power plant is under consideration by the Illinois Tractor Company.

BLOOMINGTON, ILL.—The Union Gas & Electric Company is contemplating improvements to its system, to cost about $50,000. The proposed work will include a boiler house, equipped with three new boilers, and a new exhauster house, to replace the one now in use.

CHICAGO, ILL.—Plans are being prepared for the erection of an addition to the plant of the Pullman Couch Company at Thirty-eighth Street and Ashland Street, to cost, with equipment, about $250,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

DEER CREEK, ILL.—The Deer Creek Power & Light Company, recently organized, is planning to erect an electric transmission line from Deer Creek to Cruger. Joseph A. Danforth, Samuel Belsley and others are interested.

EAST PEORIA, ILL.—Plans have been prepared by the Conover-McHenry Elevator Company of Peoria for the construction of a grain elevator in East Peoria, to cost about $250,000. E. B. Conover of the E. B. Conover Grain Company, 322 South Washington Street, Peoria, and others are interested.

HILLSDALE, ILL.—The Rock River Valley Light & Power Company has petitioned the Public Utilities Commission for permission to issue $20,000 in capital stock, and also for a certificate of convenience and necessity to construct and operate an electric light and power plant in Hillsdale, Barstow and Joplin, Ill.

NEW BERLIN, ILL.—The Central Illinois Public Service Company of Mattoon has petitioned the Public Utilities Commission for permission to erect a high-tension transmission line to New Berlin to supply electricity for lamps and motors in the town.

MANITOWOC, WIS.—Plans are being prepared by Lockwood, Green & Company, industrial engineers, 38 South Dearborn Street, Chicago, Ill., for an additional plant for the Aluminum Goods Manufacturing Company at Manitowoc, including a five-story building, 160 ft. by 280 ft., to cost about $600,000.

MANITOWOC, WIS.—Kelsey, Brewer & Company of Grand Rapids, Mich., are planning to establish an electrically operated coal dock in Manitowoc, at a cost of between $150,000 and $200,000, for handling the fuel supply of their properties in this territory. The company owns and controls a number of hydroelectric and steam generating plants in Wisconsin and eastern Minnesota. Gaylord C. Cummings is in charge of the work.

THREE RIVERS, WIS.—Plans are being completed by Lockwood, Green & Company, 38 South Dearborn Street, Chicago, Ill., for the erection of three new buildings at the plant of the Aluminum Goods Manufacturing Company, one three-story, 60 ft. by 320 ft., to cost $250,000; one four-story, 60 ft. by 300 ft., $250,000, and one three-story, 44 ft. by 137 ft., $40,000.

KELLY LAKE, MINN.—The Town Board has decided to install electric lamps on the principal thoroughfares in the town.

ST. PAUL, MINN.—The St. Paul Union Depot Company has temporarily abandoned plans for the installation of a $250,000 power and heating plant, auxiliary to the new union station. The proposed plant will not be built for at least two years. The depot company is negotiating with the Northern States Power Company for heat, light and power for the new head house which will be ready for occupancy late this summer.

ATLANTIC, IOWA.—General contract has been awarded to David G. Fisher & Company, engineers, 206 East Fourth Street, Davenport, for an addition to the municipal electric power plant. The output of the plant will be increased by 500 kw. The cost is estimated at $30,000.

DUBUQUE, IOWA.—Extensions to the ornamental lighting system are under consideration.

OTTUMWA, IOWA.—At an election held April 1 the proposal to construct and operate a municipal electric light plant in Ottumwa was carried.

CARROLLTON, MO.—The Water, Light & Transit Company is considering the installation of centrifugal pumps and other equipment at its waterworks plant. E. E. Harper of Kansas City, Mo., is engineer.

ST. JOSEPH, MO.—Swift & Company are planning to erect an addition to their boiler room, to be equipped with two 500-hp. boilers with chain-grate stokers and two boiler-feed pumps, to cost complete about $90,000.

ST. LOUIS, MO.—The Valier-Spies Milling Company is contemplating the construction of a grain elevator, to cost about $1,000,000.

SIKESTON, MO.—At an election to be held June 2 the proposal to issue $75,000 in bonds to establish a municipal electric light plant will be submitted to the voters.

LINCOLN, NEB.—Bids will be received by the city of Lincoln until April 25 for a four-cycle Diesel engine directly connected to approximately 300-kw., three-phase, 60-cycle, 4400-volt alternator, switchboard, etc. Theodore H. Berg is clerk.

OMAHA, NEB.—The Overland Tire & Rubber Company, W. O. W. Building, has awarded general contract to the Vaughn Construction Company for the construction of power house, to cost about $8,000.

OSWEGO, KAN.—Bonds to the amount of $50,000 have been voted for the installation of a municipal electric light plant in Oswego.

Southern States

LA GRANGE, GA.—Bids will be received by the town of Southwest La Grange until May 1 for construction of approximately 11 miles of sewers, disposal plant, 4 miles of water mains, storage reservoir, 2 miles of electric transmission line, one 500,000-gal. filter and one 500-gal.-per-minute horizontal centrifugal pump, directly connected to motor, and for furnishing all material. Specifications may be procured and plans seen at the office of G. H. Sargent, city engineer, La Grange. A deposit of $10 will be required for each set of plans.

BUSHNELL, FLA.—Bonds to the amount of $10,000 have been sold by the city, the proceeds to be used to establish a municipal electric light plant.

LEESBURG, FLA.—Bonds to the amount of $35,000 have been voted for the construction or purchase of an electric lighting system.

PIERCE, FLA.—Contract has been awarded by the American Agriculture Chemical Company to G. A. Miller of Tampa, Fla., for the construction of a steam turbine power plant.

SEBRING, FLA.—The Sebring Light & Water Company is contemplating improvements to its electric light plant.

CHATTANOOGA, TENN.—The Chattanooga Railway & Light Company is planning to rebuild its passenger and power station at the head of Lookout Mountain incline and also to restore the electrically driven hoist and car.

NASHVILLE, TENN.—Bonds to the amount of $60,000 have been voted for the installation of a boiler in the electric light plant.

GLOSTER, MISS.—Bids will be received by the Mayor and Board of Aldermen of the town of Gloster until April 28 for furnishing and installing an oil engine and motor-driven pump and oil-storage tank. Specifications, form of proposal, plans, etc., may be seen at office of the Mayor in Gloster, or may be obtained upon application to Xavier A. Kramer, consulting engineer, Magnolia, Miss.

ROLLING FORK, MISS.—The installation of an electric light plant is under consideration by the City Council.

BATESVILLE, ARK.—H. V. Hoyt is contemplating the installation of electric generating equipment in his grain elevator to supply electricity for lamps and motors in the village of Batesville.

DE WITT, ARK.—The Arkansas Light & Power Company of Pine Bluff has been granted a franchise to supply electricity and water in De Witt.

NEWARK, ARK.—H. V. Hoyt of Newark is contemplating the installation of an electric generator in connection with his grist mill to supply electricity for the city.

PARAGOULD, ARK.—The City Council is considering the construction of a municipal electric light plant, to cost about $100,000.

PINE BLUFF, ARK.—The Arkansas Light & Power Company has been granted a franchise to supply electricity for lamps and motors in the town of De Witt, 20 miles distant. The company now has a transmission line running to a point 8 miles from Gillette, which will be extended 12½ miles further to De Witt. H. C. Couch is president of the company.

DE RIDDER, LA.—At an election to be held April 22 the proposal to issue $90,000 in bonds for the installation of an electric light plant and pumping station will be submitted to the voters. Xavier Kramer of Magnolia, Miss., is engineer.

DUNCAN, OKLA.—Contract for equipment for power plant has been awarded to the N. S. Sherman Machine & Iron Works of Oklahoma City, Okla., at $33,000. The Benham Engineering Company, Colcord Building, Oklahoma City, has charge of the engineering work.

NEWKIRK, OKLA.—Bids, it is reported, will be received by the city of Newkirk about May 20 for rebuilding the electric light and waterworks systems, including the installation of two 40-hp. motors and three 165-hp. oil engines. H. G. Olmstead is city engineer.

FORT WORTH, TEX.—A bond issue for $50,000 to provide funds for extensions to the municipal electric light system is under consideration by the City Council.

FORT WORTH, TEX.—An election will soon be held to vote on the proposal to issue $50,000 in bonds for extensions to the municipal electric lighting system.

SAN ANGELO, TEX.—Bonds to the amount of $500,000 have been voted to construct an electric light and power plant and waterworks in San Angelo or the purchase of the plant of the Interstate Electric Corporation.

STAMFORD, TEX.—Plans are being prepared for improvements to the waterworks system, to cost about $400,000. The work will include construction of concrete dam and installation of turbine engines.

Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by the Commissioners of Kings County until May 5 for the installation of electrical exhaust blower in the basement of the County and City Building.

BRAWLEY, CAL.—The installation of a municipal electric light plant in Brawley is under consideration by the City Trustees.

LOS ANGELES, CAL.—A permit has been granted to the Clune Production Company for the erection of a dark stage and power plant.

SAN FRANCISCO, CAL.—Surveys are being made for a dam site on Pitt River above Copper City in connection with the proposed hydroelectric development by the Pitt River Power Company. The plans provide for two power developments to cost about $17,500,000. The first dam will be located near Sheep Rocks, 4 miles from Copper City, and the second dam is to be 12 miles up the river near the mouth of Totem Creek.

SALT LAKE CITY, UTAH.—Improvements to the waterworks supply lines, power plants, etc., to cost about $1,000,000, are contemplated by the City Council.

DILLON, MONT.—Plans are under consideration for the installation of a new street-lighting system and paving the streets. The cost of the entire work is estimated at about $80,000.

MISSOULA, MONT.—Engineers have been engaged by the Missoula Light & Water Company for the purpose of perfecting plans for sluicegates at the company's dam near Bonner, the cost of which is estimated at more than $60,000.

GALLUP, N. M.—The Gallup Electric Light & Power Company, recently incorporated, will take over the electric light and power plant, owned by Gregory and associates. The plant, it is understood, will be enlarged and the service improved.

Canada

SQUAMISH, B. C.—Contract has been awarded by the provincial government of British Columbia for the construction of a hydroelectric plant at Squamish to Robertson & Partners, Metropolitan Building, Vancouver, B. C., to cost about $72,000. The plant will supply electricity for the railway shops and other industries in Squamish.

BANCROFT, ONT.—The Canada Marble Company, 18 Toronto Street, Toronto, is planning to develop its quarries at Bancroft. The cost of machinery and equipment is estimated at about $500,000.

CORNWALL, ONT.—Work has begun on the construction of the proposed new substation to be erected by the Hydro-Electric Power Commission of Ontario.

FORT WILLIAM, ONT.—The Black & Muirhead Elevator was recently destroyed by fire. The building and machinery were valued at nearly $200,000.

GUELPH, ONT.—Plans are being prepared for the erection of four buildings to cost about $200,000, for the Ontario Agricultural College. F. R. Heakis, Parliament Buildings, Toronto, is architect.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 1 for furnishing copper wire and cable, brass tubing and electrical supplies, etc., under circular 1270.

Record of Electrical Patents

Notes on United States Patents

(Issued March 18, 1919)

1,297,781. LIGHTING FIXTURE; George M. Beardslee, Chicago, Ill. App. filed Aug. 28, 1917. Relation between the lamp and the shade or bowl may be adjusted.

1,297,822. DIMMING DEVICE; Otis R. Ford, Pittsburgh, Pa. App. filed May 4, 1914. Variable-resistance tube attached to automobile steering post.

1,297,857. EMERGENCY POWER EQUIPMENT FOR ALTERNATING-CURRENT SYSTEMS; Harry M. Jacobs, Schenectady, N. Y. App. filed Sept. 17, 1915. Auxiliary motor-generator set for emergency signal energy.

1,297,858. ELECTROMAGNETIC COIL; Kenneth S. Johnson, Jersey City, N. J. App. filed Dec. 10, 1917. Suppresses low frequency but permits transmission of high-frequency currents.

1,297,879. ELECTRICAL CONTROLLING DEVICE; Charles F. Lorenz, Cleveland, Ohio. App. filed April 12, 1917. Illumination intensity may be simply and easily controlled either at lamp socket or at a remote point.

1,297,903. COMMUTATOR TERMINAL AND METHOD OF MOUNTING SAME; Henry H. Phillips, Niagara Falls, N. Y. App. filed April 17, 1914. Means for attaching a commutator terminal to commutator segment.

1,297,905. TELEPHONE TRANSMITTER; Arthur P. Pinkler, Ridgefield, N. J. App. filed May 10, 1916. Microphonic.

1,297,912. DEAD-FACE SWITCHBOARD; Albert N. Rogers, Irwin, Pa. App. filed April 17, 1914. Switches mounted on rear of board.

1,297,918. PRIMARY BATTERY; Charles B. Schoenmehl and Martin L. Martus, Waterbury, Conn. App. filed Feb. 9, 1917. Prevents disintegrated material from short-circuiting battery.

1,297,919. ELECTROMAGNET; Edward Schwartz, New York, N. Y. App. filed Aug. 31, 1918. Adjustable for electric buzzers.

1,297,929. DIFFERENTIALLY CONNECTED EXPLORING COILS; John B. Taylor, Schenectady, N. Y. App. filed Sept. 28, 1915. Coils some distance apart produce sound when near fault.

1,297,931. ELECTRIC FUSE; Francis I. Thiebaut, San Francisco, Cal. App. filed April 13, 1918. Glass body with detachable end caps.

1,297,935. PROTECTION OF PARALLEL FEEDERS; Oliver C. Traver, Schenectady, N. Y. App. filed March 3, 1917. Feeder at fault individually opened.

1,297,936. PROTECTION OF PARALLEL FEEDERS; Oliver C. Traver, Schenectady, N. Y. App. filed March 3, 1917. See above patent.

1,297,938. COOKING UTENSIL; Dana P. Varner, Baltimore, Md. App. filed Aug. 30, 1918. Sounds alarm when contents reach certain point.

1,297,945. AUTOMATICALLY EXTINGUISHING ELECTRIC LIGHTING SYSTEM; John R. Warden and Howard C. Warden, Jr., Paducah, Ky. App. filed July 23, 1917. Operated by thermatic and mercury-tube circuit breakers.

1,297,953. SYSTEM OF TRANSMISSION; Max A. Whiting, Schenectady, N. Y. App. filed June 13, 1917. Prevents unstable conditions in induction motors for driving hoists.

1,297,965. ELECTRIC RIVETING APPARATUS; Neil MacNeale, Cincinnati, Ohio. App. filed Aug. 25, 1916. Electrode and a riveting die are applied successively.

1,297,966. ELECTRIC RIVETING APPARATUS; Neil MacNeale, Cincinnati, Ohio. App. filed Sept. 26, 1916. See above patent.

1,297,979. MAGNETICALLY CONTROLLED SWITCH; Herman L. Van Valkenburg, Milwaukee, Wis. App. filed April 7, 1916. Used in connection with motor starter.

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1,297,989. REGULATOR FOR MOTOR-GENERATOR SYSTEMS; John A. Bairns, Detroit, Mich. App. filed July 24, 1915. For automobiles.

1,297,996. SWITCH FOR ELECTRIC CIRCUITS; Carl Bramming, Chicago, Ill. App. filed Oct. 16, 1917. Automobile use.

1,298,000. TIME-INDICATING SYSTEM; James W. Bryce, Bloomfield, N. J. App. filed Sept. 7, 1917.

1,298,032. ELECTRICALLY CONTROLLED ELEVATOR; Floyd C. Furlow, Montclair, N. J. App. filed April 22, 1915. Small direct-current generator driven by elevator supplies energy to storage battery.

1,298,107. ELECTRICAL SYSTEM; Karl A. Simmon, Edgewood Park, Pa. App. filed March 4, 1916. Supplied from line circuits of relatively high and variable potentials and delivers currents of low and constant potential.

1,298,148. ELECTRODE OF SECONDARY BATTERIES; Edward F. Ablitt, London, Eng. App. filed Oct. 31, 1918. Can be rolled up into spiral forms with separators between them.

1,298,155. MACHINE FOR POINTING METALLIC ARTICLES BY ELECTROLYTIC ACTION; Marcus O. Anthony, Englewood, N. J. App. filed Aug. 4, 1916.

1,298,175. AUTOMATIC HEAT ALARM; Paolo Cardone. Brooklyn, N. Y. App. filed Feb. 23, 1918.

1,298,179. INCANDESCENT ELECTRIC LAMP; Jacob H. Coggins, Talladega, Ala. App. filed Jan. 22, 1917. Multi-filament.

1,298,217. INTERCOMMUNICATING SET; George M. Jenkins, Paris, France. App. filed Nov. 3, 1917. Strapped to head of pilot and observer in an aëroplane.

1,298,225. MAIL BOX FOR RURAL DISTRICTS; Alexander F. Krieger, St. Joseph, Mich. App. filed Sept. 25, 1915. Wheels of mailman's vehicle open cover of box to permit ready insertion or removal of mail.

1,298,237. TELEPHONE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed Nov. 21, 1917.

1,298,293. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Oct. 29, 1917.

1,298,297. INSULATED WIRE; William E. Cook, New York, N. Y. App. filed April 24, 1917. Outside braid dispensed with, covering for wire being held in place partly by an adhesive.

1,298,299. ELECTRIC INCANDESCENT LAMP; John H. Dale, New York, N. Y. App. filed Jan. 20, 1915. Heat insulator placed between wall of lamp and metallic base.

1,298,301. WATER-HEATING SYSTEM; Virgil E. David, Omaha, Neb. App. filed April 1, 1918. Heater operates water-controlling means.

1,298,321. TERMINAL BANK; Oscar F. Forsberg, Yonkers, N. Y. App. filed March 29, 1916.

1,298,322. LOCK-ACTUATED CIRCUIT BREAKER FOR IGNITION SYSTEMS OF EXPLOSIVE ENGINES; Otto Forthmiller, Minneapolis, Minn. App. filed April 5, 1918.

1,298,330. CONTACT BANK; Charles L. Goodrum, New York, N. Y. App. filed June 19, 1917. Conductors readily inserted, removed or adjusted.

1,298,339. TELEPHONE SYSTEM; Harvey L. Harris, Elyria, Ohio. App. filed April 26, 1915. Responding party cannot connect his receiver to conductors that are connected to source of ringing current during ringing period.

1,298,354. SWITCHING SOCKET; George C. Knauff, Chicago, Ill. App. filed Jan. 17, 1917. Circuit made or broken without relative movement of the two terminal carriers.

1,298,365. TELEPHONE-EXCHANGE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed Oct. 20, 1917.

1,298,375. ELECTROMAGNETIC POWER-TRANSMITTING APPARATUS; Alfons H. Neuland, San Francisco, Cal. App. filed Aug. 8, 1914. Driven member may rotate at different angular velocity from that of driving member.

1,298,376. ELECTROMAGNETIC TRANSMISSION; Alfons H. Neuland, New York, N. Y. App. filed Jan. 18, 1916. Capable of exerting greater pull than applied torque.

1,298,384. ILLUMINATOR FOR WRITING ELEMENTS; Byron L. S. Perrin, Ottawa, Ontario, Can. App. filed July 18, 1916. Lamp illuminated by replacing cap upon rear end of fountain pen.

1,298,396. CONDENSER; Albert Pruessman, Berwyn, Ill. App. filed Dec. 18, 1916. Multiple-unit type.

1,298,400. MACHINE-OPERATING MECHANISM; Lynus C. Reynolds, Washington, D. C. App. filed July 6, 1918.

1,298,414. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed July 15, 1915. Telephone line released immediately after conversation is terminated.

1,298,420. AUTOMATIC SIGNAL; Harvey E. Tharp, Smith Center, Kan. App. filed Sept. 14, 1917. When pneumatic tire becomes deflated to a certain degree a signal is actuated.

1,298,421. ZIGZAG CARBON ELECTRIC RESISTOR; John Thomson, New York, N. Y. App. filed April 16, 1918. Carbon element rendered immune to oxidization.

1,298,433. ELECTRICAL SYSTEM OF POWER TRANSMISSION AND REGENERATIVE BRAKING; Clinton J. Axtell, Schenectady, N. Y. App. filed Feb. 4, 1918. Variations in speed upon braking torque produced are compensated.

1,298,440. AUTOMATIC TRANSMITTER; George R. Benjamin, Jersey City, N. J. App. filed April 26, 1915. Perforated tape controls closing and breaking of plurality of contacts.

1,298,441. TELEPHONE SYSTEM; Sidney A. Beyland, North Ridgeville, Ohio. App. filed June 23, 1915. Ringing controlling means released for further use after ringing connections have been completed.

1,298,442. ELECTRICAL SYSTEM FOR MOTOR VEHICLES; Joseph Bijur, New York, N. Y. App. filed July 7, 1914. Constant-current regulation.

1,298,443. TRANSFORMING DEVICE; Theodore Bodde, Lynn, Mass. App. filed April 13, 1916. Constant current obtained from constant-potential sources without employing devices having moving parts.

1,298,457. VARIABLE RESISTANCE; Theodore W. Case, Scipio, N. Y. App. filed Feb. 9, 1917.

1,298,462. ELECTRIC RAILWAY CONTROL SYSTEM; Charles B. Connely, Scotia, N. Y. App. filed Nov. 10, 1915. Switches automatically respond to a change in voltage.

1,298,464. ELECTRIC SWITCH; John L. Creveling, New York, N. Y. App. filed Dec. 29, 1911. Automatic, for generator supplying storage batteries.

1,298,465. GENERATOR; William W. Dean, Stamford, Conn. App. filed April 25, 1917. Tripolar core-structure type has flux-generating element producing flux reversals.

1,298,490. ELECTRICAL OSCILLATION GENERATOR; Leonard F. Fuller, San Francisco, Cal. App. filed July 12, 1916. Arc generator has large power output in proportion to size.

1,298,505. AUTOMOBILE RADIATOR; Mortimer C. Hollister, Elgin, Ill. App. filed June 19, 1917. Heater for protecting radiator against freezing.

1,298,513. TREATING LIQUOR FROM REDUCING PROCESSES OF NITRATED COAL-TAR DERIVATIVES; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 26, 1918.

1,298,534. IGNITION DYNAMO; Charles T. Mason, Sumter, S. C. App. filed April 19, 1916. Condenser attached directly to circuit by metal terminals.

1,298,562. ADJUSTABLE SUSPENSION DEVICE; Timothy B. Powers, New York, N. Y. App. filed Dec. 13, 1917. For hanging electric lamp.

1,298,569. APPARATUS FOR EXHAUSTING INCANDESCENT LAMPS; Robert Le Rossignol, Berlin, Germany. App. filed Jan. 30, 1917. Large number of lamps exhausted and sealed at same time.

1,298,588. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed Nov. 12, 1914. Line-circuit and other apparatus automatically released at end of call.

1,298,589. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed June 19, 1915. Single set of controlling mechanism for substation signals at each operator's position.

1,298,590. ELECTRIC ARC WELDING; Andrew Smith, San Mateo, Cal. App. filed Aug. 17, 1914. Weld produced by series of utomatically controlled steps.

1,298,603. WELDING CONTROLLER; Edwin B. H. Tower, Jr., Milwaukee, Wis. App. filed March 11, 1915. Circuit is always in condition for safe operation.

1,298,608. FUSE BOX; Albert A. Wells and Harry B. Fife, Detroit, Mich. App. filed Aug. 29, 1917. Cover containing fuses opened and drawn down and away from box to permit renewal of fuses safely.

1,298,609. SHEATHED-WIRE TERMINAL; Arthur M. Wentworth, Pittsfield, Mass. App. filed Sept. 25, 1918. Separate elements fit snugly over ends of core wire.

1,298,613. WIRELESS SIGNALING SYSTEM; William C. White, Schenectady, N. Y. App. filed April 23, 1915. Either receiving apparatus or transmitting apparatus automatically connected to antenna.